THE ILLUMINATING ENGINEER
THE JOURNAL OF
GOOD LIGHTING
LIGHT
LAMPS
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AND
ILLUMINATION
OIL
GAS
ELECTRICITY
ACETYLENE
PETROL-AIR
GAS
ETC.
OFFICIAL ORGAN of
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Tests Relating Visual Effort to Illumination

ILLUMINATING engineers at the present time are anxious to demonstrate to the public the benefits of good illumination, but they are constantly "up against" the lack of really satisfying and scientific data showing how the efficiency of various processes may be improved by higher illuminations.

Most of us would agree that, within limits, higher illuminations enable the eye to work with greater precision and more quickly. Ruffer, as a result of experiments with a large number of test-processes in a Berlin laboratory, found that in almost all cases there was marked improvement up to 1 foot-candle. Thereafter, there was still substantial improvement up to 10 foot-candles in most cases, after which the influence usually became less. He concluded that the best value of illumination was usually between 10 and 20 foot-candles, though in some cases of exceptionally difficult work improvement persisted up to much higher values.

The difficulty, however, is to draw conclusions for definite processes. In most industrial operations the eye is only occupied for part of the time; for the remainder the action is automatic. Ives has inferred that the degree of influence exerted by illumination would depend on the relative proportion of these two periods, and has attempted to deduce formulæ on this basis. The well-known D.S.I.R. research on typesetting by hand led to the belief that full efficiency in this exacting process might require 20-25 foot-candles. But it would be rash to assume that this applied to office or factory work generally.

From time to time various interesting devices for testing vision and relating illumination to visual effort have been devised.

Some time ago we referred to an ingenious visual test devised by Dr. M. Luckiesh and Mr. F. K. Moss—the chief feature of which was a series of discrimination diagrams executed on a pack of cards. The same idea has now been carried into effect in a somewhat different way, by assembling the information and test-diagrams in book form. The book before us contains sixteen plates, each occupying a page, and each page is divided into four spaces, thus making a total of 48 "cards." Each card has a uniform grey surface, and over this diagonal lines in darker hue are printed—each line, however, having a minute gap in it so that the points thus produced trace out a letter of the alphabet. These letters, however, are not at once apparent. Their detection is a somewhat severe visual test, the degree of difficulty of the process (as measured by the time occupied) being affected by the intensity of illumination which the surface receives.

In the authors' experience something like 5-6 foot-candles is necessary to detect these letters with any ease, and the process would seem too wearisome to impose on large numbers of non-technical people, especially if their vision were faulty. Moreover, the adoption of the diagonal lines increases enormously the difficulties of people with pronounced astigmatism—to such folk the line pattern appears unstable, and concentration on a long series of tests would probably bring on a headache. After so much care and skill and expense have been devoted to this device, which is beautifully executed, it may seem ungracious to criticize; one cannot help thinking, however, that the device would be more successful (1) if the "dots" were somewhat larger and easier to pick out, and (2) if they were created by the application of two washes of different darkness, instead of by interruptions in dark diagonal lines on a somewhat less dark background.

Contemplation of such devices suggests one interesting speculation—to what extent does the shape of the curve connecting visual performance and intensity of illumination depend on the nature of the task? Manifestly one could select visual tests so easy that they could be done almost as readily by 1 foot-candle, or even half a foot-candle, as by 10 foot-candles. In such cases one would obtain a curve which would "flatten" very quickly, i.e., after quite a low illumination was reached no apparent improvement in vision would result.

On the other hand one might devise a test involving observation of detail so minute that illumination of 10 foot-candles or upwards might be necessary before the detail could be detected at all! Such tests might appear to lead to the inference that 50 or even 100 foot-candles was desirable for perfect vision. There is also the consideration that the apparent flattening of a curve depends to a great extent on the scale to which it is drawn.

All such experiments tend to prove one thing—that acuteness of vision does improve with higher illuminations. But the inference to be drawn in regard to "standards" of illumination for such daily tasks as reading, writing or type-writing is less evident. Clearly the test-process should bear as close a resemblance as possible to the operation for which standard illuminations are desired. There is evidently a wide scope for enquiry here.

Light as a Factor in Street Accidents

SOME months ago we referred to some investigations in France which served to illustrate the relation between lighting conditions and accidents in streets. These statistics, obtained by Commandant Serin, who is in charge of the Police District of l'Oise, are now analysed in detail by Monsieur J. Wetzel in *Lux* (November, 1930).

The data are the result of more than 100,000 *procès-verbaux*. The statistics somewhat resemble those available in this country in that accidents are divided according to cause, but apparently no effort was made to separate those occurring at night from those occurring by day, nor to study conditions of public lighting. Even in spite of this, however, M. Wetzel is able to draw a number of useful conclusions.

In the first place it is recorded that out of 383 accidents in 1927, 42, i.e., about 11 per cent., were attributed to defects in lights on vehicles or dazzling headlights. These, therefore, were directly associated with light.

Next there were 214 accidents, of which 118 were due to vehicles being out of position (e.g., on the wrong side of the road), and 96 were ascribed to excessive speed. M. Wetzel rightly regards this class of accident as in part due to inadequate lighting. A car in the wrong place is a very much more dangerous obstruction by night than by day. A speed which might be justified in full daylight becomes hazardous by night. This class of accidents amounted to 55 per cent. of the total. The remainder, due to such causes as bad conditions of roads, mechanical failures, want of skill of drivers, etc., are less definitely associated with lighting conditions.

Greater vigilance on the part of the police led to a reduction in accidents in this area in 1928, and it is thought that the insistence of gendarmes on proper procedure in regard to vehicle lights had much to do with this. Other interesting deductions are drawn from the monthly records of accidents. Accidents on country roads tend to rise in the summer months, the rise commencing in May and attaining a maximum in July. This is a natural consequence of the tourist season and reflects the increasing number of vehicles on the road. After this month the accident rate diminishes—but why does it rise again abruptly in *October*, when tourist traffic should be diminishing? The inference is that this rise is due simply to the shorter daylight hours, involving more driving by artificial light. Examination of accidents throughout the hours of the day leads to the same conclusion. The peak of the accident curve occurs at 18 hrs., i.e., 6 p.m., which is the period of rush traffic home and also the period of dusk. It is significant that the hourly accident rate at the time of the morning rush is very much less.

These facts are adduced by M. Wetzel to support a claim for adequate artificial lighting of roadways and especially those in rural areas, which at present are liable to be neglected. It will be seen that an analysis of records of street accidents—collected on the ordinary basis and without any preliminary planning to enable effects of lighting to be traced—can lead to quite useful conclusions. If day and night accidents could be separated, and if inadequate lighting in streets were included amongst the recorded causes of mishaps we cannot doubt that very convincing evidence of the part played by unsatisfactory illumination would be obtained.

A Message to Public Lighting Engineers

ON January 1st, 1931, Mr. J. S. Dow, who is Hon. Secretary of the Illuminating Engineering Society, also became Hon. Secretary of the Association of Public Lighting Engineers, in succession to Capt. W. J. A. Liberty, one of the founders of the Association, who has served it so well from its inception.

The new arrangement will, it is hoped, prove advantageous to the Association in various ways—for example in facilitating co-operation between the Association and the Illuminating Engineering Society. These two bodies, whilst having separate constitutions and fields of operation, have the distinction of being the only two societies in this country exclusively concerned with illumination. The Association is, of course, professionally interested in street lighting; the Illuminating Engineering Society, which takes all applications of light within its province, is interested in street lighting also, though from a somewhat different aspect. There should be many ways in which these two societies could help each other, and could exert their united influence to raise the status of public lighting.

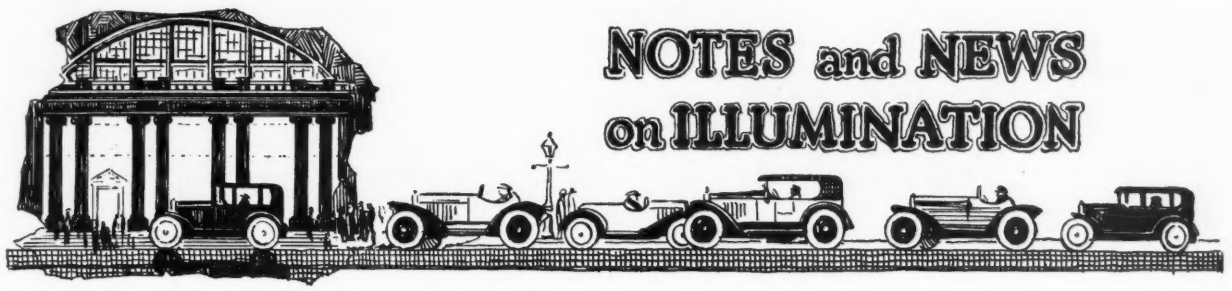
We would like to take the opportunity of mentioning another feature of the new arrangement, which we hope will also be beneficial to the Association, namely the fact that this journal is becoming its official organ. Every member of the Association will be receiving *The Illuminating Engineer* each month. We hope that each one of them will feel that it is *his* journal, anxious to serve him and the Association in every possible way.

We look forward to publishing full accounts of the Annual Conferences and of the Association (as indeed we have done in past years). These annual conferences are looked forward to by many outside the ranks of the Association as occasions when the position in street lighting is reviewed and interesting topics are discussed.

We have always felt, however, that the interval between these annual conferences—an inevitable consequence of the fact that public lighting engineers are scattered throughout the country and can only be assembled once a year—is somewhat long.

What can be done to bridge the gap? We invite opinions on this point; but there is one way at least in which public lighting engineers can maintain contact with each other. There must be, from time to time, many local events, special installations or problems in lighting which would be of general interest to members of the Association. We would gladly publish any interesting notes of this kind that members can send us from their respective districts. The President-elect, Mr. Beveridge, has kindly set the ball rolling by sending us an illustrated account of a striking concealed lighting installation in Edinburgh (see p. 13). Occasional notes of this kind are most helpful in showing what public lighting engineers are doing throughout the country.

May we conclude by wishing members individually a happy new year and the Association an eminently prosperous one?



The International Illumination Congress, 1931

In our last number we reproduced the provisional programme of the International Illumination Congress, which takes place in this country during September 2nd–12th. Programmes and preliminary attendance forms have been circulated amongst members of leading societies interested. We are asked to mention that it would be a great help to the Hon. General Secretary (Col. C. H. S. Evans, 32, Victoria Street, London, S.W.1) if those who hope to take part in the Congress would fill in and return these forms *now*—thus enabling a provisional estimate of the attendance to be made. We may, perhaps, take this opportunity of clearing up one little misconception. Whilst the members of the Congress will naturally include official delegates, representatives of Government Departments, etc., anyone interested in illumination is eligible to apply for registration as a member. If there are any of our readers, at home or abroad, who would like to take part in the Congress, but have not actually received particulars, we should be very pleased to see that programmes are dispatched to them.

Lectures on Illuminating Engineering

Readers will find elsewhere in this issue a summary of the first of the series of Cantor Lectures recently delivered by Professor Charles R. Darling before the Royal Society of Arts, which was mainly concerned with lighting problems. We now learn that a series of three lectures, entitled " The Art of Illumination," is to be given before the Royal Institution at 5.15 p.m. on Tuesdays, January 20th, January 27th and February 3rd, by Dr. John W. T. Walsh (Past President of the Illuminating Engineering Society). The first lecture will be mainly historical, the second will deal with Artificial Lighting, and the third with Daylight. Members of the Illuminating Engineering Society and readers of *The Illuminating Engineer* do not need to be told that a series of lectures of this kind from Dr. Walsh is certain to prove both entertaining and instructive. Applications for tickets should be addressed to the Secretary of the Royal Institution, Albemarle Street, London, W.

Calendar Reform

Readers may recall that in our issue of September, 1930, we drew attention to the need for a reformed calendar and to various schemes of simplification that have been proposed. In commenting on the matter then we overlooked the fact that the problem has been for years before the League of Nations, which, in 1927, invited opinions on the merits of schemes based respectively on the division of the year into 12 or 13 months. In a pamphlet prepared by Mr. E. K. Eason, of Dublin, the need for reform and the comparative merits of these alternative schemes are very ably set out. Mr. Eason prefers the 12-months' system, which, on the whole, appears to involve least disturbance with existing methods, and to be the simpler in operation. Specimen resolutions to be passed by representative organizations are included in Mr. Eason's book. We confess that our own inclination still leans to the simple plan mentioned in our September issue (12 months, each of 30 days' duration, the remaining five days being " non-days " or holidays, and unnumbered), but it is evident that there must be some sacrifice of individual views. The chief need is to support the League of Nations in its effort to attain agreement and give practical shape to this reform. Perhaps the Illuminating Engineering Society would be prepared to consider this important problem and adopt a resolution in favour of reform.

The Lighting of Booking Halls and Waiting Rooms

We acknowledge freely that much has been done to improve the lighting of booking halls and waiting rooms at terminal railway stations, as compared with the really appalling conditions that prevailed a few years ago. The lighting of booking halls is certainly better. In some cases illuminated pictorial placards have helped to create a cheerful appearance. The fluorescent paintings exhibited by the light of quartz-tube mercury-vapour lamps at Waterloo Station formed an ingenious novelty, whilst at King's Cross Station (which the writer had formerly regarded as one of the most dismal!) brightly lighted pictorial placards, some relating to travel, others advertisements, have appeared. Railway stations, however, have certainly been slow to make improvements in the lighting of waiting rooms. At some stations, where the lighting is otherwise promising, there are waiting rooms where one can scarcely see to read by artificial light, and the effect is dispiriting and inhospitable to a degree. We shall perhaps be told that this is deliberate. Passengers should not be encouraged to linger in waiting rooms; too comfortable conditions are apt to attract undesirable frequenters who are not bona-fide travellers. We have heard a similar idea expressed in regard to public libraries. We confess it seems to us a mistaken view. Surely, if a waiting room exists at all, it should be reasonably well furnished, warmed and lighted for the benefit of genuine travellers, and other means should be found to discourage the undesirable element. This case illustrates how lighting problems are apt to be disturbed by " the human element."

Better Lighting in Mines

In a recent debate in the House of Commons on accidents in mines, Mr. Shinwell, Minister of Mines, endorsed the vital importance of better lighting conditions. There was a general belief that miners' nystagmus was mainly due to inadequate illumination, and that many surface accidents and fatalities were due to faulty lighting. It was intended to circulate proposals for improving the lighting of coal mines and mine faces. These proposals would relate not only to the raising of the minimum candle-power of the miners' safety lamps but also to the relaxation of the present statutory restrictions on methods of lighting other than by safety lamps at the coal faces.

Physical and Optical Societies

TWENTY-FIRST ANNUAL EXHIBITION.

As previously announced, the above exhibition is taking place during January 6th–8th, 1931, at the Imperial College of Science, South Kensington. Over 80 firms are exhibiting, and in order to mark the twenty-first anniversary of the exhibition, Sir Arthur Eddington, F.R.S., is performing the opening ceremony. Discourses include "Searching for Minerals with Scientific Instruments " (Mr. E. Lancaster Jones, January 7th) and " The Physics of Sport " (Professor Sir Gilbert Walker, January 8th).

Spectacular Lighting in Belgium

Although the decorative lighting at the Barcelona International Exhibition attracted a considerable amount of attention, the spectacular illumination devised in connection with the centenary festivals in Brussels, Anvers and Liège, and other Belgian cities seems to have received relatively little notice. Nevertheless, this lighting, especially that undertaken in connection with the exhibition at Anvers, seems to have presented numerous interesting features, and a description by Monsieur P. Brune in *Lux* (November, 1930) is well worth study. Floodlighting naturally played a leading part. In the illustrations, however, one observes other methods which seem to be becoming almost standard in Continental practice—notably the lining of avenues with luminous pillars or obelisks, such as were adopted in the Edison celebrations in Amsterdam. Another curiosity is the lighting of an avenue by indirect fittings on posts, each consisting of a series of four concentric luminous rings of diminishing diameter. In his final summary of the exhibition, M. Brune recognizes nine distinct types of luminous elements, which are illustrated by descriptive sketches. Besides the ring fittings and obelisks noted above, these devices include various types of illuminated pillars, masses of coloured globes, "precious-stone" effects obtained by illuminating masses of vari-coloured glass with changing light, and singular decorative devices which are described as "Cactus" and "Asparagus" units!

The Lighting of the Stage of the New State Opera House in Vienna

In *Die Lichttechnik* Dr. Hans Koch gives a description of the lighting of this new Opera House, which seems to be on an elaborate scale. About 60 km. of mains are used for the stage lighting, and the dimmers and control resistances, 131 in number, seem exceptionally complete. One gathers that the methods of lighting are on familiar lines, though use is made of many different types of appliances. Incandescent lamps up to 1,000 watts are in general use. A somewhat exceptional piece of equipment is a battery of 18 high-power mercury-vapour lamps, which, with the aid of filters, are expressly designed to furnish azure-blue light. An interesting feature of the footlights is that the sides being designed to furnish the usual range of coloured light, either direct or indirect lighting effects can be secured. This seems a useful innovation in view of the recognition that the hard shadows cast by unscreened lamps in footlights are often objectionable. Spotlights, likewise equipped to furnish coloured light, are available on the stage, but are also mounted at four places in the auditorium, suitable lodging places being apparently specially provided for in the architectural scheme. The variety of lighting units mounted on the horizontal bridge supports is impressive, and includes a special form of cloud projector and two panoramic devices for the development of moving atmospheric effects.

Illuminating Engineering in South Africa

We have just received a copy of the annual report of progress of the S.A.E.L.A. Lighting Service Bureau, which has headquarters in Johannesburg, and is under the direction of Mr. E. S. Evans. We hope to comment more fully on these developments shortly, but it may be said that an encouraging start has been made.

Lighting Progress in the United States

The Report of the Committee on Progress, presented at the twenty-fourth Annual Convention of the Illuminating Engineering Society (U.S.A.), in October last,* is this year exceptionally brief, but contains several interesting items of information. Experience resembles that reported for this country; there have been no sensational developments, but much steady progress in detail. This is illustrated by the data given for electric incandescent lamps. The average lumens per watt attained 13.2 in 1929—an advance of 25 per cent. over the figure of 10.5 recorded for 1919. Attention is drawn to two main developments in arc lamps, the silencing of commutator ripples in arcs used in sound-motion picture studios, and the introduction of super high-intensity projector carbons operated at currents of 250 amperes. Incandescent lamps of large capacity are being increasingly used. It is stated that the 3-kw. size is most popular, but 10-kw. lamps are in commercial use, whilst experiments on 20, 30 and 50-kw. sizes are being continued. The tungsten powder mechanical cleaner is stated to have proved successful and to have increased the average light output during life by nearly 45 per cent. The number of lighted airports increased during 1929 from about 75 to over 300—truly a very rapid development. Incandescent lamps are most widely used in this field owing to ease in manipulation, but it is stated that a special carbon-arc searchlight, equipped with a lens throwing a flat beam of wide horizontal distribution, has been developed for the lighting of landing grounds. In gaseous-tube lighting the chief developments have been the introduction of hot cathode types capable of being used on ordinary lighting circuits and the development of combinations of coloured tubes to produce a subjective white light.

Architectural Lighting

The illustrated descriptions of "architectural-lighting" installations, a number of which have now been issued in booklet form by the Illuminating Engineering Society, U.S.A., have been continued in recent issues of the *Transactions*. Recent installations described include an original design in the Chrysler Building, which is based on the combination of coloured marble and nickel-chrome steel, with tubular lamps. (Diffusing glass and stainless steel have likewise been the main elements in some recent installations in London; for example, at the recently redecorated Strand Palace Hotel.) In other interiors described one observes a tendency to eliminate pendant fittings, so as to get a clear view throughout the room. This is evident in the Central National Bank, Richmond, Va., which utilizes only wall fittings throwing light upwards on to a vaulted ceiling. From this system of indirect lighting an illumination of 4 to 5 foot-candles is provided, but 15 to 24 foot-candles is provided on the counters by special local units. The trading room in the Board of Trade Building in Chicago is likewise notable for the absence of pendant chandeliers. In this case light is provided by an octagonal fitting, 38 ft. across, and recessed into the ceiling. This, it is stated, carries no less than two hundred and twenty-eight 500-watt lamps. Smaller units of similar design, each housing twenty-eight 500-watt lamps, are mounted in the four corners of the room, which is of imposing dimensions (166 ft. long and 112 ft. wide, with a 57-ft. ceiling).

* *Transactions* of the Illuminating Engineering Society (U.S.A.), pp. 711–713, October, 1930.

TECHNICAL SECTION

COMPRISING

Transactions of The Illuminating Engineering Society and Special Articles

The Illuminating Engineering Society is not, as a body, responsible for the opinions expressed by individual authors or speakers.

Glass for Use with Invisible (Ultra-Violet and Infra-Red) Rays

(Proceedings at the Meeting of the Illuminating Engineering Society, held in the Lecture Theatre of Messrs. Holophane Ltd., Elverton Street, Westminster, S.W., at 6 p.m., on Friday, December 12th, 1930.)

A MEETING of the Illuminating Engineering Society was held in the lecture theatre of Messrs. Holophane Ltd., Elverton Street, Westminster, S.W.1, on Friday, December 12th, 1930. Members assembled for light refreshments at 6 p.m., and the meeting commenced at 6-30 p.m., when the chair was taken by the President (Lt.-Col. K. Edgcumbe).

After the minutes of the last meeting had been taken as read, the HON. SECRETARY announced the names of the following applicants for membership:—

Ordinary Members.

Banham, C. P. .....Illuminating Engineering Department, Messrs. Edison Swan Electric Co. Ltd., 155, Charing Cross Road, London, W.C.2.

Bennett, M. G. .....Meteorologist, Kew Observatory, Richmond, Surrey.

Hunter, T. G. .....Electrical and Ventilating Engineer, 3, St. James's Square, Manchester.

Jepson, A. E. .....Assistant District Manager, General Electric Co. Ltd., Cotefield, Hathersage, Sheffield.

Wheat, H. C. .....Chief Electrical Engineer, Messrs. Edison Swan Electric Co., 155, Charing Cross Road, London, W.C.2.

Country Members.

Bailey, W. C. G. .....Electrical Fittings Salesman, 80, Heath Bank Road, Higher Blackley, Manchester.

Booth, W. L. .....Electrical Engineer, General Electric Co. Ltd., 15, Buller Road, Manchester.

Damant, Lieut.-Commander Eric L. Baxter, H.M.S. *Vernon*, Portsmouth, Hants.

Swarbrick, J. .....Architect and Surveyor, 14, John Dalton Street, Manchester.

It was mentioned with pleasure that Mr. H. C. Wheat, who had been a member of the Society in its early stages, was now rejoining.

The names of applicants presented at the last meeting of the Society were read again, and these gentlemen were formally declared members of the Society.*

The PRESIDENT then called upon Dr. S. ENGLISH to read his paper, entitled "Glass for Use with Invisible (Ultra-violet and Infra-red) Rays," which was illustrated by numerous experiments. After a brief explanation of the nature of the spectrum and the various forms of radiation included therein, the author passed on to ultra-violet rays, and referred especially to the narrow band extending from 295μ to about 320μ, which is regarded as of importance in relation to health. He showed how such rays are absorbed by ordinary window glass, and summarized recent efforts to produce varieties of glass permeable to them (in some circumstances showing a transmission of about 73 per cent.).

The phenomenon known as solarization, i.e., the progressive change in the glass caused by exposure to sunlight, was described. Reference was made to some of the chief artificial sources of ultra-violet light, including recent types of gasfilled incandescent and mercury-vapour lamps.

The production of glass permeable to ultra-violet but opaque to vision rays, and its use in the construction of ultra-violet testing cabinets, was explained. A series of striking experiments showing the fluorescence of various objects under the action of ultra-violet rays was performed. Fluorescence affords a ready method of testing the transmission of glasses to ultra-violet rays, and has been made the basis of numerous forms of special analysis (e.g., in discriminating genuine gems from false ones, natural teeth from artificial teeth, etc.).

The concluding portion of the lecture was devoted to glasses used with infra-red rays, amongst which special importance attaches to glasses with poor heat-transmission, such as have proved valuable in the tropics, and for roof-lights even in this country.

The paper led to an interesting discussion in which Mr. F. W. HODGKIN, Mr. A. W. BEUTTELL, Mr. J. S. DOW, Mr. R. WALKER, and Mr. P. BARTON took part.

A vote of thanks to Dr. English for his paper, and to Messrs. Holophane Ltd., terminated the proceedings, after which the PRESIDENT referred briefly to various forthcoming events, particulars of which will be found below.

(Dr. English's paper and the ensuing discussion will appear in our next issue.—ED.)

* *The Illuminating Engineer*, December, 1930, p. 289.

The Illuminating Engineering Society

(Founded 1909; Incorporated 1930).

ANNOUNCEMENTS OF FORTHCOMING EVENTS.

The Illuminating Engineering Society has now been duly registered under the Companies Act, 1929, as a limited company. In accordance with the Articles of the Society, a General Meeting will be held at 28, Grosvenor Gardens, Victoria, London, S.W.1, at 7 p.m. on **Monday, January 12th, 1931,** prior to the Sessional Meeting. The proceedings will be purely formal.

Immediately after the above formal meeting, a Sessional Meeting of the Society will be held. A paper on **"Recent Developments in Gas Lighting"** will be read by Mr. E. L. OUGHTON, and will be followed by a discussion.

The **Annual Dinner** of the Illuminating Engineering Society will be held at the TROCADERO RESTAURANT, Piccadilly Circus, on **Tuesday, February 10th, 1931.** Members may bring ladies as their guests. The price of tickets will be 15s. (exclusive of wine). The dinner will commence at 7 for 7-30 p.m., and will terminate at 9-30 p.m., after which a hall will be available for dancing. Applications for tickets should be made to the Hon. Secretary (Mr. J. S. Dow, 32, Victoria Street, London, S.W.1).

Visit to L.G.O.C. Works at Chiswick

ABOUT 40 members of the Illuminating Engineering Society took part in a visit to the works of the London General Omnibus Co., on Friday, December 12th, and the majority of these availed themselves of the special covered bus which had been arranged to convey the party from St. James's Park Station to Chiswick. This was of the latest covered type, and was equipped with roof lighting from horizontally sunk diffusing dishes.

The congestion of traffic in the streets made the journey rather a slow one, and the commencement of the inspection of the works was somewhat delayed. The extent of the workshops and test yard is in any case so enormous that a flying visit of an hour or less can only give a general impression of the organization and of the part lighting plays during the winter months.

The members, having divided into small parties, were conducted through the various departments, and it was noticed that the chassis and engine department was entirely separate from that devoted to bodywork. In the latter the coachwork of old buses is reconditioned and transformed to bring it into line with modern requirements, and large numbers of entirely new bodies are manufactured ready for fixing to the chassis as turned out in the other shops.

One noticed the special use of illumination in the vertical plane for painting work, this being effectively produced by means of 150-watt opal lamps, without any special reflectors. It was understood that reflectors had been fixed, but that the staff preferred the diffused but bright light given by the exposed opal lamps. During the progress of reconstruction and painting the coachwork is moved steadily forward by slow-moving ropeways to which the car trolleys can be gripped. In the nearly completed buses it is desirable to have the bus lamps in lighting, and this is effected by means of transformers for reducing the voltage from the normal works lighting pressure to the 16 volts required for bus lamps. In order that the lighting shall be maintained while the bus is moving forward the current is conveyed by a slide on an overhead trolley wire. The opportunity is taken to use up old lamps during repairs.

In the section of the works devoted to overhaul of engines and chassis, a well-organized progress system is adopted. On opposite sides of a vast floor area are two moving platforms travelling very slowly (about 16 ins. per minute). On the incoming platform the chassis are gradually stripped and completely taken to pieces, the various parts being left at succeeding bays as the platform moves on. The parts are then moved transversely along the bays, being completely overhauled as they pass across the building. Having arrived at the other side, they are gradually assembled on the other slow-moving platform which is travelling in the reverse direction, and as each bay is passed a further part is picked up, until finally the completed chassis is ready to pass through to the test yard, one complete unit being turned out every half-hour.

The lighting for all this work is mainly of a general character, and is furnished by R.L.M. reflectors, which seem very suitable for the purpose. It was understood that the general average of illumination is about 4 foot-candles, though 10 foot-candles is provided for special work, such, for example, as lathes, where special concentrating angle reflectors were fitted for directing the light straight on to the work. It is worthy of note that there is an entire absence of any visible lamp filaments throughout the works.

Two special devices may be noted: the use of overhead patterns of coloured lamps, whereby the supervisors of any section of the works can be summoned to the telephone by headquarters; and the mounting of bold illuminated plates, bearing the words "Lighting Switches," and enabling anyone to see from a distance where the switches are located.

The magnitude of the electrical installation can be judged from the fact that the load on the 11,000-volt lines, as laid in from Lots Road power station, is 83 amperes. Of the total load over 300 kw. is due to lighting. The members had an opportunity of viewing the sub-station where the supply is transformed down to a suitable three-phase system at 415 volts for power, the lighting voltage being between phases and neutral.

At the conclusion of the tour of the works, members had the privilege of making a close inspection of the very latest type of bus, which was drawn up outside the main offices. Lighting is no inconsiderable item in these latest types, there being a load of about 600 watts in all. The total number of lamps in use, including signs, headlights and upper and lower decks, is 53. This includes a special portable fog light designed to enable the driver to pick out the kerb when driving close in.

The Lighting of the Home

PROFESSOR CHARLES R. DARLING, in the first of his series of Cantor Lectures, delivered before the Royal Society of Arts on November 24th, 1930, dealt mainly with domestic lighting. Reference was made to two national schemes now progressing which were designed to affect the future of domestic lighting very profoundly. The first of these, the National Grid System, aimed at making electricity available to almost every inhabitant of the country. It should also result in a reduction in price—in fact, if it was not ultimately found possible to bring this down to 1½d. or 1d. per unit, the scheme could not be said to have realized the fullest hopes of its supporters. The other project, namely, the low temperature carbonization of all bituminous coal, would, if it succeeded, result in a much larger quantity of gas being made available. These two schemes were not necessarily antagonistic—it was quite possible for gas and electricity to work together in harmony.

The lecturer then touched on the considerations which governed the adequate lighting of rooms. A simple demonstration with a sheet of newspaper and a candle served to illustrate the meaning of the "foot-candle." A striking model, consisting of a miniature house glazed with a ground-glass screen, and with removable walls, illustrated the lighting economy which was effected by the use of large rooms consequent upon the reduction in wall surface. Of interest also was the recommendation of a minimum illumination of 6 foot-candles for dwelling-rooms—a value which, we venture to suggest, is not realized in many homes to-day. This necessitated a lamp of 180 candle-power to illuminate a room with light-coloured walls measuring 15 ft. by 15 ft. by 10 ft. The problem of glare was overcome by the use of translucent glassware. Lighting fittings were also becoming more and more prominent as decorative features in themselves, and several lantern slides showing this aspect of gas and electric lighting were exhibited.

The various forms of light-source available for domestic use were then briefly reviewed. The evolution of the electric glow-lamp was traced from the first carbon-filament lamps, whose only rival was the bats-wing gas burner, to the vacuum, and finally the gas-filled lamp, in which a still higher filament temperature was attained. Further modern developments were the daylight-blue and internally frosted bulbs.

Dealing with gas lighting, Prof. Darling remarked that the design of burners had been scientifically studied, and great care was exercised in their construction. This point was illustrated by slides showing the stamping of injector plates and by photomicrographs of injectors.

The efficiency of all light-sources was deplorably low—it was only by producing cold light that high efficiency could be obtained. As an example of cold light, the lecturer performed a very striking experiment in which one or two crystals of a hydrazine derivative of phthalic acid were dropped into dilute sodium hypochlorite solution, and produced flashes of a curious blue light.

The Lighting of Offices and Public Buildings

By J. A. MACINTYRE

DISCUSSION

(In what follows we give a summary of the discussion of Mr. J. A. Macintyre's paper on the above subject, which was read before the Illuminating Engineering Society on November 14th, 1930, and appeared in the December issue of this journal (pp. 290–294).—ED.)

The PRESIDENT (Lt.-Col. K. EDGCUMBE) complimented Mr. Macintyre on his paper, and expressed the hope that architects would express their views thereon. He called upon Mr. P. J. Waldram to open the discussion.

Mr. P. J. WALDRAM explained that owing to pressure of work he had only been able to study the paper for a short time prior to the meeting. A desire to hear the views of architects had been expressed, and he would do his best to present a defence to some of the criticisms of the paper.

These criticisms were evidently based upon defects in daylight planning in some offices in Whitehall, such as the fact that nearly all the offices at the ground level had no windows in the outer walls. The meagre daylight obtained from the bottom of deep light wells was wholly inadequate, and clerks had to work continuously by artificial light. It was by no means certain, however, that this was done by architects merely for the sake of external appearance. Possibly it was not foreseen that the huge growth of Ministerial activities would cause these particular rooms to be used as offices; they might have been deliberately planned for protection in emergencies and as a generous space for the keeping of important documents; or possibly the architects were desired to keep all office windows well above the eye-level of passers-by.

As a member of the Council of the R.I.B.A., which appointed the assessors in public competitions, he asserted with confidence that a competitor who did not make adequate fenestration a main factor in his design would stand no chance in a competition conducted under these conditions. The declared policy of the Royal Institute in regard to the permissible heights and density of buildings in towns was directed solely to conserving what light was left, to the exclusion of all other considerations. The gold medal of the Institute had just been awarded to the new Underground Railway offices in St. James's Park—easily the best and most striking example of offices deliberately planned for daylight in an obstructed situation. Finally, the whole of modern knowledge on daylight illumination, its measurement and predetermination, and the methods of applying such knowledge, was due to the architectural profession.

The author had stated that the Waldram method of estimating daylight factors (by which was meant presumably the accurate measurement and predetermination of daylight factors) involved so much work that it was not being used to forecast daylight conditions on plans. Actually such methods had been used by himself and others in some 1,500 to 2,000 cases. It had been recently stated in evidence in the Courts by a well-known architect that no architect or surveyor of experience would use any other method—possibly an exaggeration, but an indication that this method was not confined to a few. The author had expressed a desire for some more practical method. Technical Paper No. 7, on "Penetration of Daylight and Sunlight into Buildings," recently issued by the Department of Scientific and Industrial Research, contained a full description of a very simple and straightforward approximate method, which involved a minimum of labour. This method of tracing "no-sky" contours was well within the capacity of any junior draughtsman.

The author had selected one example out of five alternative designs of light wells illustrated in Mr. West's paper. That paper considered the problem of lighting the interior rooms of a block of offices occupying an island site 200 ft. square, surrounded by roads 60 ft. wide, lined with buildings all carried up to the limits permissible under the London Building Act. When he (Mr. Waldram) had suggested to the British National Committee a paper giving alternative treatments of this problem, such as would illustrate the advantages of light wells of unconventional design, he anticipated that it would be applied to the characteristics of modern office buildings. Mr. West, however, had applied to each alternative design features characteristic of Government Offices in Whitehall. There were also apparent errors in the tables of comparative figures given in Mr. West's paper. Thus the author, quoting from that paper, had given the area of the light well in the plan shown as 12,000 square feet, whereas the area of a well 120 ft. by 120 ft. was obviously 14,400 square feet.

He (Mr. Waldram) had been interested to work out the problem upon the lines of ordinary commercial buildings. Allowing a thickness of 14 ins. to the external walls and 3 ins. for the partitions with the corridor width of 8 ft. adopted by Mr. West, the extravagant plan illustrated had the following characteristics:—

	Square feet.	Percentage.
Light Wells	13,070	32.7
Walls and Partitions	2,110	5.3
Stairs, Lifts and Lavatories ...	1,040	2.6
Corridors	5,540	59.4
Office Space	18,240	
	40,000	100.0

Comparison of this with a less conventional design, with open instead of totally enclosed light wells, was somewhat striking:—

	Square feet.	Percentage.
Light Wells	11,360	28.4
Walls and Partitions	2,250	5.6
Stairs, Lifts and Lavatories ...	1,040	2.6
Corridors	5,880	63.4
Office Space	19,470	
	40,000	100.0

The line of demarcation between adequately and inadequately lit office space was taken by Mr. West in his paper as the "no-sky contour," at which all visible sky at table height was shut off between the window head and the top of the obstruction. This was the simple method for predetermining daylight conditions on drawings, referred to above.

If this criterion was applied it would be found that open-ended light wells gave much lighter rooms, with greater area of office space.

The author had suggested that legislation to improve on the figures he had quoted was improbable for many years. It was all the more encouraging, therefore, to note that material improvement has been effected by unconventional design with a definite object—which was not regarded as heresy by the chief architectural authority in this country, but rather as a meritorious effort.

In conclusion, Mr. Waldram remarked that whilst he had dissented from some of the references made in the paper to modern architects, he felt that grateful thanks were due to the author for introducing a subject of such vital and national importance. The designer of even a small office building, likely to last for say 50 years and housing say 200 clerks, was, by the details of his design, affecting the comfort, the well-being and the health and stamina of workers for something like 20,000,000 working hours.

Mr. A. W. BEUTTELL referred to the design of light wells. Presumably the main object was to get as much

light as possible to enter the windows of rooms near the bottom of the well. He understood that it was the usual practice for the sides of the well to be made of glazed tiles, from which there must be a good deal of specular reflection. He wondered whether the use of this kind of surface was desirable and whether any experiments had been made with dead-white surfaces?

Evidently there would be a vast difference between the illumination of the floor of a light-well and the illumination of the vertical wall. Would it not be possible to improve access of daylight by mounting suitably inclined mirrors on the floor of the well, so as to reflect direct light upwards and inwards on to the upper parts of walls and ceilings of rooms around the well?

Mr. HOWARD ROBERTSON said that the subject dealt with in the paper was of very great importance. In any building where natural lighting presented difficulties the windows ought to start at the edge of the room, adjoining the partition. There was often a substantial piece of wall between the edge of the window and the partition. His experience of modern work abroad was that where a window was used with no pier the adjacent surface of the wall had an important reflecting value. In many cases the method of placing of windows was such that no benefit was obtained from the partition wall.

He wished that Mr. Macintyre had made more definite proposals in regard to the artificial lighting of offices. One type of fitting that had struck him (Mr. Robertson) as having possibilities was that incorporating lamps in duplicate, one giving downward light and the other applied to direct light upwards.

Mr. ARTHUR BLOK could not agree with the author's statement that there was no evidence either from the point of view of health or output that appeared to justify higher figures for foot-candles than 3, 2.5 and 2. Those figures seemed to him remarkably low. The American code specified 5 to 10 foot-candles for general offices, and 8 to 15 for drawing offices. Authentic American values going well into 10 to 15 candles as standard everyday practice in commercial office lighting had been published, and that could not be entirely due to American enthusiasm or to the propaganda of organizations interested in extending the sale of electricity.

The United States Public Health Service as a result of investigations carried out in 1923 had recommended an initial minimum of 10 foot-candles for sorting in post offices. It might be that some of that work required special discrimination, but the figure was certainly a long way above the figure referred to by the author.

Mr. Blok then briefly described the investigation and cure of a case of bad lighting in a Government office, viz., the Patent Office, London, where the lighting of the rooms of the examining staff had been recently overhauled and considerably improved in consultation with H.M. Office of Works. Prior to these improvements most of the rooms were lighted by non-frosted vacuum lamps in shallow conical opal or enamelled iron shades with an allowance of one 20-watt lamp per desk and one 30-watt lamp per outlet for general illumination. The lamps were hung in more or less random positions, and were often found at eye level over the desks. The installation as a whole showed a bad combination of glare and low illumination values.

An investigation of the eyesight conditions confirmed the view that considerable improvement was needed, as it was found that of the 210 officials whose eyesight was investigated no fewer than 56 per cent. had visual defects. These were:—

	Cases.
Astigmatism	26
Hypermetropia	13
Astigmatism plus Hypermetropia	19
Myopia	19
Astigmatism plus Myopia...	39
Other defects	2

The work of these men is twofold: (i) Desk work involving the perusal of ordinary print and typescript,

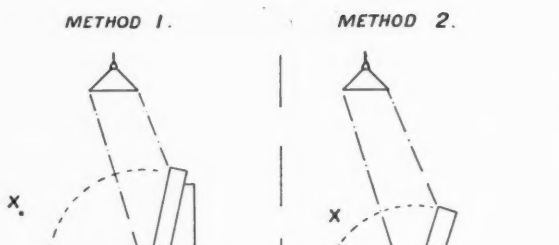
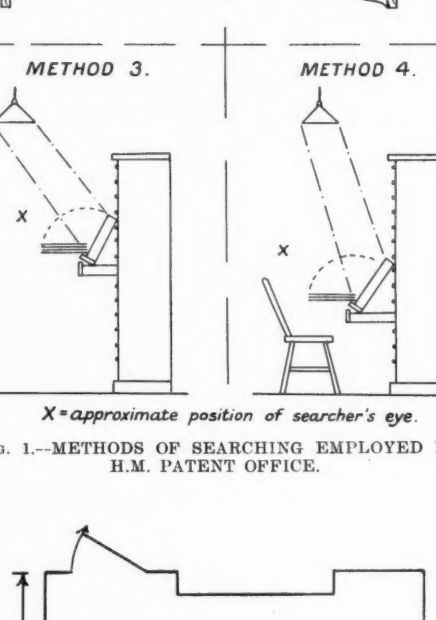
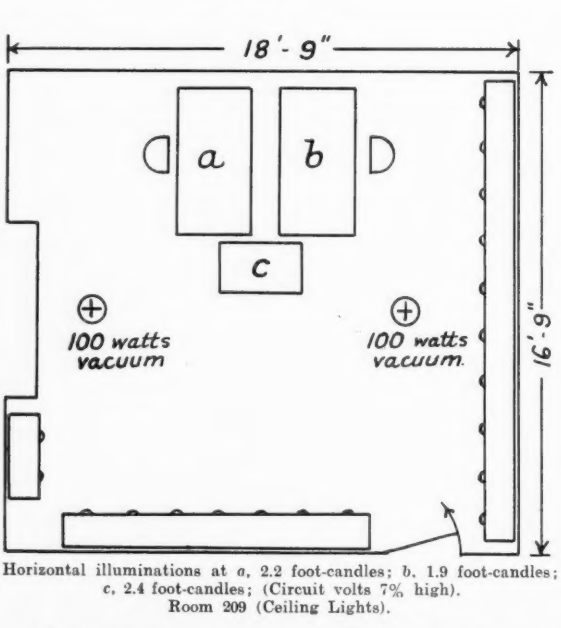


FIG. 1.—METHODS OF SEARCHING EMPLOYED IN H.M. PATENT OFFICE.



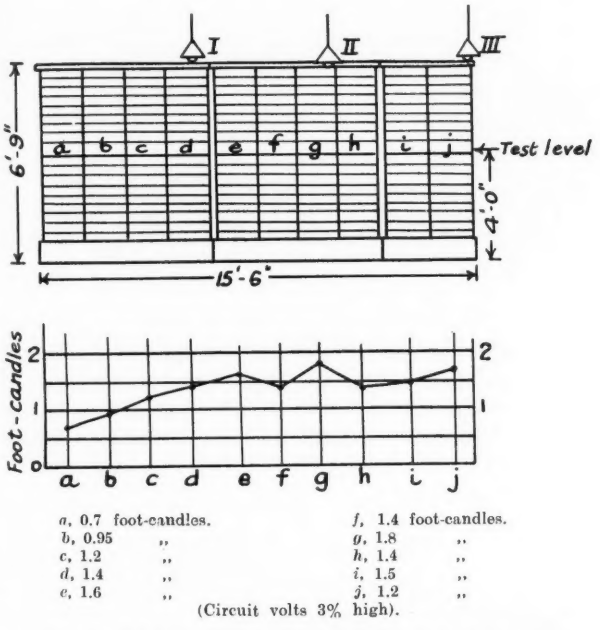
Horizontal illumination at *a*, 1.8 foot-candles (Circuit volts 6.5% high) Room 106 (Pendants).



Horizontal illuminations at *a*, 2.2 foot-candles; *b*, 1.9 foot-candles; *c*, 2.4 foot-candles; (Circuit volts 7% high). Room 209 (Ceiling Lights).

FIG. 2.—HORIZONTAL ILLUMINATION ON DESK TOPS.

and, in addition, much close scrutiny of black-and-white line drawings somewhat resembling those of an engineer's draughtsman; and (ii) the prosecution of the statutory search for novelty in connection with new applications for letters patent. This searching necessitates examining closely the contents of large numbers of previously issued printed patent specifications and drawings, which are pasted on cards and stored in the search files of the Patent Office. It involves great visual exaction, inasmuch as the searcher turns constantly from the printed text to the drawings, hunting for the relevant reference letters or numerals and disentangling fine details among drawings which are frequently of a very complicated nature. Various methods of searching are employed in accordance with the examiner's practice of supporting his drawer of search material on a stand on his desk or on a bracket at its front edge, or, alternatively, of supporting it on another drawer projecting from the cabinets of search material. In such case the cards are successively inspected and turned downwards on their predecessors, as shown in Fig. 1.



a, 0.7	foot-candles.	*f*, 1.4	foot-candles.
b, 0.95	,,	*g*, 1.8	,,
c, 1.2	,,	*h*, 1.4	,,
d, 1.4	,,	*i*, 1.5	,,
e, 1.6	,,	*j*, 1.2	,,

(Circuit volts 3% high).

FIG. 3.—ILLUMINATION IN VERTICAL PLANE ALONG SEARCH FILE CABINET.

Typical values of the horizontal illuminations found on the desk tops are shown in Fig. 2 for two rooms, viz., a small one lighted by two pendants having 20-watt and 30-watt vacuum lamps in opal cones, and a larger one with two 100-watt vacuum lamps mounted on the ceiling without reflectors or shades. Representative values of the vertical-plane illuminations at a level 4 ft. above the ground (applicable to search method 3, Fig. 1) along a row of search file cabinets are shown in Fig. 3. This row of cabinets received a small share of the general illumination of the room, but was lighted chiefly by one 20-watt and two 30-watt lamps, with opal cones hung just in front of the cabinet, as shown at I, II, III in the upper part of the figure.

A solution for all this bad lighting was ultimately found in the adoption of two special types of lighting fitting and a slight increase in the size of the desk lamps. For the desks it was decided to replace the opal cones by deep bee-hive-shaped opal shades, one per desk, each fitted with a 40-watt "Pearl" gasfilled lamp, and hung at such a level that the lamp was normally invisible, and could not be seen unless the examiner definitely put his head in an unusual position and looked upwards. These shades were not close enough to the eyes to create glare. Each of these fittings was hung from a pulley which ran on a short length of curtain rail secured to the ceiling above the desk, and extending obliquely from a point approximately above the centre of the examiner's desk to a point somewhat behind his shoulder, usually the left one. Thus, by flicking the pulley to one end or the other of the rail, he could bring the lamp to the optimum position both for normal desk work or for searching by either of methods 1 and 2 shown in Fig. 1.

For search methods 3 and 4 a portable metal-bracket arm was devised with a down-turned inner end which could be inserted in the looped handle of any drawer in the cabinet. The outer end of this bracket arm carried a spun steel bell-shaped reflector pointing downwards and inwards towards the face of the cabinet. This reflector cleared the head of the searcher, and its inner surface was finished in aluminium paint. For search method 3 the bracket was slipped into the handle of one of the topmost drawers, in accordance with the height of the searcher, and for method 4 into the handle of a lower drawer. Each bracket carried a 20-watt vacuum type of lamp, and had a flexible head with a bayonet adapter, which could be plugged into the most proximate of a number of empty bayonet lampholders, which were provided in the rooms in positions accessible to all of the search cabinets without danger of fouling of the leads.

By these simple devices and by increasing the lamp allowance from 30 to 40 watts per desk, it had been found possible at a small cost to eliminate glare, to bring up the horizontal illuminations on the desks to a figure between 10 and 12 foot-candles, and to increase the illuminations on the search cards when in their approximately vertical positions for searching to values which range from about 18 foot-candles at the upper part of the cards to 8 foot-candles at the bottom corners.

Mr. H. T. YOUNG advised members to see the beautiful picture by Sir James Guthrie in the National Gallery. It was a splendid example of what British artists could do. He was less satisfied, however, with the colour media adopted for the lights. The colour of the light needed to be selected with special reference to the picture shown; he recalled a case in which blue eyes in a portrait were caused to stand out ludicrously owing to the adoption of blue light. On other eyes a distinctly yellowish light may have a similar effect. He suggested, however, that it was a mistake to adopt a colour of light in one room in a picture gallery which was in strong contrast to that in an adjacent room. This upset the judgment. The ordinary gasfilled lamp gave light of a colour to which the eye was accustomed after the fall of darkness. He knew cases where, owing to the fancy of the artist, under-run vacuum lamps were used to bring out reds and yellows. In one particular case he had in mind the artist would not approve of the ordinary lamp on the ground that even this was too cold; he insisted on having a 230-volt lamp run at 200 volts.

A material advance in the general tone of artificial lighting towards daylight values had been made since the days of the carbon-filament lamp, but until the resemblance to daylight was much closer he thought that it was a mistake to light offices and galleries with artificial daylight.

The best-lighted picture he could recall was one illuminated from the roof in the national collection at Amsterdam. By means of a spotlight a strong illumination was directed on the picture, the remainder of the room being left in semi-darkness. In the course of further remarks Mr. Young exhibited lantern slides illustrating the use of 3-duct and 2-duct conduits for lighting, power and telephone.

Mr. P. GOOD referred to Mr. Waldram's defence of the architect. He (Mr. Good) was neither an architect nor a lighting expert. What Mr. Waldram said was broadly true of the architectural work of the last few years. But it should be remembered that architects had been at work for thousands of years; hence there were scores of buildings the lighting of which had been much neglected until the illuminating engineer came upon the scene. In fact, the interest now taken by architects in lighting matters was largely due to the urge from the engineering side. In his experience architects in pre-war days had little knowledge of

heating, lighting and ventilation. When the Examining Board of the London County Council were preparing a syllabus for architectural students he had suggested that something about these subjects should be included. He had had considerable difficulty in getting this suggestion adopted.

Mr. Good referred to certain offices overlooking St. James's Park where daylight illumination had been destroyed by great stone bastions. He had taken a considerable interest in the lighting of typists' offices, and had formed the conclusion that it was quite feasible to avoid local lighting. In an office of this type under his supervision the illumination was 5 to 6 foot-candles; he believed that general lighting was undoubtedly best.

Mr. H. H. LONG said that he did not think many people would agree with the author's estimate of the desirable intensity of illumination required for clerical work. There was, in fact, a considerable amount of evidence available showing the influence of better lighting on quality and output of work. He might mention briefly the detailed tests undertaken by the United States Public Health Service. It had been found that for people with good vision in post-office sorting offices an increase in illumination from 3.6 to 8 foot-candles had resulted in an increase in output of 26.3 per cent. It should also be remembered that many people had more or less defective vision, and were more seriously affected by insufficient light than those with normal sight. He believed that in the tests he had quoted a substantial reduction in errors, besides an improvement in output, had been secured. This was an important matter when one considered the expense that a single unfortunate error might cause.

Added: In a written communication since received Mr. Long refers to this matter in fuller detail. He recalls that the recommendation of the Advisory Committee, approving 2.5 foot-candles for clerical work, was made over ten years ago. It was not clear on what evidence the recommendation was based, but there is ample published evidence to justify higher figures. Mr. Macintyre mentions elsewhere that at the Ministry of Pensions building the 4 foot-candles provided in 1921 is now being increased to 6½ foot-candles. Surely there must be some justification for this increase.

Mr. Long now quotes more fully the conclusions arrived at by Dr. J. E. Ives in his investigation for the United States Public Health Department,* which were as follows: For maximum output the clerks with good vision require 8 foot-candles, and those with poor vision 14 foot-candles, both supplemented by general illumination. An increase from 3.6 foot-candles to 8 foot-candles resulted in an increased output of 26.2 per cent. in the case of those clerks with poor sight, whilst the errors were reduced by 65 per cent. The latter figure may be somewhat astounding, but one must realize that if only two errors are committed, and one of these is eliminated, there is a reduction of 50 per cent. right away.

The cost of one error alone in clerical work may be of such a nature as easily to cover the whole cost of better lighting many times over, but the report also shows that 1 per cent. gain in output covers this in itself.

Amongst other data, Mr. Long refers to the report on research carried out by the French Academy of Science,† indicating that a 10 per cent. increase in output is obtained by doubling the illumination, and to the fact that the National code of America gives a legal minimum of 4 foot-candles for clerical work, whilst recommending intensities in the neighbourhood of 10 foot-candles. The further influence of coloured paper, as compared with white, must also be considered.

Mr. Long points out that the only official investigation on this subject, i.e., Technical Paper No. 6, indicates an optimum value of 20 foot-candles for typesetting. It would be of distinct value if this investigation could be extended to clerical and other forms of work.

In conclusion, Mr. Long remarks that salaries and overhead expenses in offices are generally relatively higher than in factories; hence it is particularly desirable that the illumination should be adequate.

Mr. W. J. JONES, in a written contribution, expresses his interest in Mr. Macintyre's paper, which contains enough data and information to permit discussion on three very widely different problems, namely, those of (*a*) daylight in buildings, (*b*) the lighting of art galleries, (*c*) the lighting of ordinary offices.

Mr. Jones confines himself to the last two topics. He remarks that the lighting of art galleries is one of peculiar difficulty, bearing in mind the common construction of the buildings. The aim and the necessity of directing light towards the pictures, and keeping the central portion of the galleries in comparative darkness is well known. One method adopted in the Art Gallery at Brussels consists in lining the junction of the roof lantern with the ceiling with 60 or 100 watt tubular lamps in suitable reflectors. With careful screening, the lighting equipment is quite inconspicuous during daytime, and at night-time provides ample illumination on the pictures themselves. One is glad to learn that there is some possibility of our national treasures being illuminated in the near future. The cost of retaining the pictures in the nation's possession is 500 to 1,000 times greater than that of providing the necessary artificial illumination to enable the pictures to be seen to advantage when daylight fails.

Mr. Jones also criticizes the recommendations of the Advisory Committee of 1920, endorsed by Mr. Macintyre, and dissents from the suggestion that there is no evidence from the point of view of health or output that justifies higher figures than 2 to 3 foot-candles. Mr. Jones continues: "I would ask the question whether there is any medical evidence to show that the eye works equally efficiently under low intensities as under high intensities so commonly experienced during daytime. I am unaware of any such evidence. On the contrary, Dr. Hartridge has shown that at 3 or 4 foot-candles the eye operates at 25 per cent. of its maximum visual acuity; and it seems logical, therefore, that if it is asked to perform a task under such adverse lighting conditions, it must necessarily do so with some strain which, in the long run, must have a permanent effect on visual performance."

After quoting the remark of an eminent physiologist, who has expressed a preference for an illumination intensity of 20 foot-candles or more for ordinary indoor office work, Mr. Jones mentions that a recent survey in some of the larger offices in London and the provinces show conclusively that business houses are already employing intensities which are double that suggested by Mr. Macintyre, whilst values of 8 foot-candles are now being recommended by a consulting engineer responsible for some of the largest buildings in London. Business houses adopting such values are not anxious to waste light, but know that higher intensity exerts a profound influence on the well-being of their staff.

Mr. Jones concludes: "Unless, therefore, the nature of the work in Government offices is so widely different from that obtaining in commercial practice, I am of the opinion that the values put forward by Mr. Macintyre are totally inadequate in view of present-day requirements. I am further of the opinion that the limit on intensity of artificial lighting which is to be provided is an economic one, and that even here the strictures are more apparent than real."

Capt. E. J. HALSTED HANBY writes confirming the close attention given by modern architects to provision of natural lighting—a matter with which consulting engineers rarely concern themselves.

He comments on the singularity of the practice of determining conditions of lighting by "trying it on the dog"; in other words, the user. He did not concur in the principle that if a person who knows nothing about light or its applications expresses a personal preference, then that preference should be taken as a correct solution!

He opposes the suggestion that medical evidence is lacking in support of the theory that higher illuminations provide greater ease of vision. He asks what

* *Illuminating Engineer*, April, 1925.

† *Transactions*, Illuminating Engineering Society, U.S.A., October, 1929.

medical evidence, apart from successive tests of eyesight, does Mr. Macintyre require. Surely, the experience of business houses, which is concerned with profits that are dependent on efficiency, is of value? Captain Halsted Hanby also remarked on the impression that higher values of illumination are only valuable for "special work," and instances numerous familiar processes (accounting, reading, typing, etc.), where increases from 3 to 5 or 6 foot-candles have been found beneficial. He suggests that the basis of the author's conception rests on the fact that two foot-candles of natural daylight enabled one to see well, and that a similar number of foot-candles of artificial light would perform the same miracle. The dissimilarity of the spectra must be taken into consideration. It would be found that, for equal illumination, visual acuity by daylight and artificial light were in the proportion of two to one.

It must therefore be an error to base ideas of the requisite intensity of illumination by artificial light on one's experience when working by good natural daylight.

Mr. L. T. MINCHIN, after congratulating Mr. Macintyre on his most interesting paper, mentions that he has recently been concerned with the lighting by gas of a small drawing office employing a combination of desk lights and totally indirect lamps, which has so far given great satisfaction.

A gas-lighted Drawing Office; indirect lighting and local desk units combined.

The indirect system consists of three 20-in. square stainless-steel reflectors suspended from the superheater of three 5-light medium lamps, producing an average illumination of 3.5 foot-candles, which is quite adequate for the general lighting, blue-print machine, developing bench, etc. The utilization factor is about 17 per cent.,* but it should be remembered that the room is of inconvenient shape, and that this illumination cannot easily be reduced by shadows, as is the case with direct lighting.

The local lighting is made up by bench standard lamps, on swivel arms, with green opal shades and single-light large burners, producing an illumination of 30 foot-candles on the drawing-boards. The even lighting of the room is shown in the accompanying photograph, which is taken by the normal lighting only, both local and general lighting being in use at the time.

* Based on the luminous output of the bare source.

Mr. H. F. SIMON (*communicated*) refers to the remark of Mr. Macintyre that in offices where a large number of typists and draughtsmen were employed more individual lighting could be used with advantage if it was not for the fact that from time to time the tables had to be shifted about from one position to another.

This objection, he suggests, could be got over in two ways. According to one of these methods one erects along the back of the desks a wood batten approximately 1½ ins. wide, mounted at each end on a 1-in. tubular support, fitted with a screw-down circular base. On the wood batten are screwed small metal fitments to take the stem of the ordinary adjustable local lighting fitting. The rack itself is fed from a sunk plug in the floor, and connected to this by an ordinary length of cab-tyre flex to an iron box fitted to the base of the vertical upright. In this manner the use of trailing flexibles is avoided.

With this method of lighting each employee is enabled to have the advantage of using an adjustable lighting unit, which, being brought close to the work, does not require more than a 15 or 25 watt lamp to give ample lighting intensity on the typewriter and surrounding surface.

An alternative scheme, when the lights are not too close together, is to bring out the flexible cord from the head of the lighting unit, at the end of which is an adapter, and feed this from a holder dropped from the ceiling rose in the ordinary way.

Mr. Simon agrees with Mr. Macintyre that it is easier to design a general scheme of lighting, but he considers it more important to devise methods of arranging a lighting scheme which will give typists a form of light which they really need, and which is adjustable according to the requirements of each user. The policy of extreme economy exercised in the designing of lighting installations in many Government offices is a mistaken one. The saving made in the upkeep of such installations is surely a secondary importance compared to the baneful effect of permitting young girls and youths to work under unsatisfactory lighting conditions.

(*Mr. Macintyre's reply to this discussion has been held over until our next issue, in order to allow the author adequate time to deal with the numerous points raised.*—ED.)

Brightness Distribution Due to Inter-Reflection in a Light-Court

The contribution on the above subject by Mr. E. W. Manning and Mr. H. D. White, which appears in the *Transactions* of the Illuminating Engineering Society (U.S.A.) for September, 1930, is timely in view of the discussion on the design of light wells in Mr. Macintyre's paper. The authors deal with the problem by calculations, in which a matt reflecting surface for the interior surfaces of the well is necessarily assumed; but it seems probable that a departure from this condition will not very greatly affect the available illumination at the bottom of a well in practice. The effects of variation in the coefficient of reflection of the walls, however, are very important indeed, a change from zero to 0.9 in the reflection factor multiplying the light twenty-fold.

What, however, is perhaps the most interesting section of the paper is that dealing with the influence of a reflecting bottom to the well. It was suggested in the discussion of Mr. Macintyre's paper that upward reflection might be valuable in giving better access of light to rooms at the bottom of a well. In some calculations it is shown that the available illumination may be doubled by introducing a bottom having the same reflecting power as the walls. Moreover, such reflected light enters the rooms at the base of a well at a much more favourable angle than light received direct from the sky.

Public Lighting in Glasgow

An exceptionally comprehensive report has been issued by Mr. S. B. Langlands, the Inspector of Lighting to the City of Glasgow, for the two years from June 1st, 1928, to May 31st, 1930.

Glasgow is a big city, and its lighting is in a state of constant expansion. Thus the additional length of streets lighted during the two years was no less than 46 miles. In the same period 2,680 public lamps have been added, bringing the total up to 33,844, without including 151 private lamps which are under the charge of the Lighting Department.

This increase in the total number of lamps has been accompanied by steady advances in candle-power. Thus, in many cases, 4-light gas burners have taken the place of single-light burners, whilst 100-watt electric lamps have replaced 60-watt lamps. Development has been especially rapid along the Corporation bus routes. In some cases, after 100-watt lamps have been introduced, as mentioned, these in turn have been superseded by 300 and 500-watt types.

A curious feature of the lighting in Glasgow is the very large number of "stair-lights," 895 of which were added during the two years, making the total 88,352. In this field electric lighting is proving of service in reducing the labour involved in lighting separate lamps on a single stair, (2) in enabling lamps on a number of stairs to be grouped under the same control, (3) in reducing the interval of time between the earliest and latest lit stairs, and (4) in transferring men employed on stair lighting gradually from a partial to a full-time occupation.

The Corporation housing schemes have involved a considerable amount of lighting work, which is described in detail in the report. Other improvements noted include (*a*) the placing of additional lamps at certain points where lighting has been the subject of complaint, (*b*) the special measures taken to secure adequate illumination of traffic policemen, who are now to be furnished with white coats, (*c*) the introduction of danger lamps consisting of ruby well-globes, each containing a 30-watt lamp to mark refuges, etc., (*d*) the erection of illuminated traffic signs of various kinds, and (*e*) the introduction, for the first time in Glasgow, of automatic traffic-control colour signals, in which the Lighting Department has co-operated.

We may next note the successful introduction of remote and co-ordinated control of electric street lamps along main thoroughfares and extensive housing areas, and the experiments now in progress with automatic control by the selenium bridge. Finally, this busy Lighting Department has now added to its tasks the maintenance of about 100 public clocks.

A Challenge to the Sun

Under the title "Our Final Challenge to the Sun," Dr. M. Luckiesh describes the application of the new sunlight incandescent lamps, which, by making use of the spectrum of luminescent mercury, contribute an appreciable amount of ultra-violet energy as well as visible light.

It is suggested that this "dual-purpose" lighting may solve the problem of those interiors into which natural light cannot readily be admitted. It has been several times argued that instead of constructing costly light wells it would be more economical, as well as sounder practice, to rely exclusively on central ventilating systems and artificial lighting, abandoning windows.

This idea, it is suggested, is brought nearer the practical stage by "dual-purpose" lighting, which furnishes the ultra-violet element ordinarily supposed to be provided by access of natural daylight. As an instance of an interior equipped with "dual-purpose" lighting, Dr. Luckiesh describes the treatment of studios of the National Broadcasting Company in Chicago. Thirty-six special sunlight units, mounted on the under-side of the ceiling beams, were used. The lamps are mounted in special fittings consisting of concentric cylinders of oxidized aluminium, so that the light is diffused and the source completely hidden from the eye. These units are mounted 20 ft. above the floor, and furnish an initial intensity of 25 foot-candles. This should produce a minimum perceptible erythema upon untanned skin in about 80 minutes, as compared with 20 minutes in midsummer sunlight. Thus, it is suggested, we have a satisfactory equivalent for sunlight.

Elsewhere it is inferred that a daily exposure of about one-tenth that necessary to produce a minimum perceptible erythema is adequate for health maintenance. If so, it would seem that an illumination substantially below the 25 foot-candles might be sufficient.

Sheffield Illumination Society

SYLLABUS FOR 1931.

As we go to press we receive the programme of the above Society for 1931. The opening event is a social evening on January 5th, after which there is a visit to Museum Observatory, Weston Park (February 2nd), a visit to the Tramway Depot (March 2nd), and a Review of Street Lighting (March 9th). June 20th is devoted to the annual outing, on this occasion to Matlock; and on October 12th there will be a discussion on Street Lighting. Other items include a talk on "Wireless" (November 2nd), a visit to Fire Brigade Headquarters (November 9th), and the Annual Meeting and Presidential Address (December 7th).

Spectacular Floodlighting

The description of the floodlighting of the Acropolis at Athens, illustrated in our November issue, has kindled a spirit of emulation, and we have received several pictures of striking floodlighting installations. We are indebted to Messrs. B. A. G. Turgi, a Swiss firm that has made a speciality of illuminating engineering, for the accompanying picture. This night view shows the floodlighting of the ancient fortress of Bellinzona. The special lighting was undertaken during a recent international shooting contest. As in the case of the Acropolis, the isolated position of this castellated building helps considerably to produce a a striking effect.

POPULAR & TRADE SECTION

COMPRISING

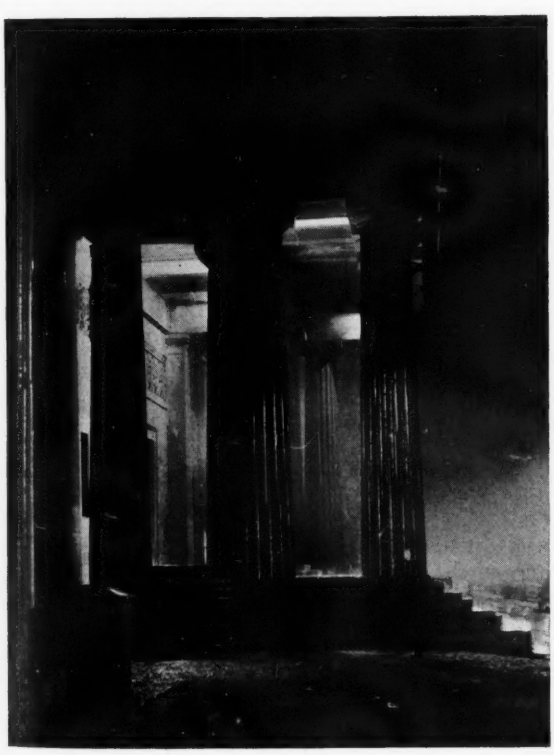
Installation Topics—Hygiene and Safety—Data for Contractors—Hints to Consumers

(The matter in this section does not form part of the official Transactions of the Illuminating Engineering Society and is based on outside contributions.)

An Interesting Example of Concealed Lighting

WE are indebted to Mr. R. Beveridge, Inspector of Lighting and Cleansing to the City of Edinburgh, for the striking picture which accompanies this note, which shows the illumination of the north portico of the Royal Scottish Academy of Art in Princes Street. The pleasing silhouette effect has been obtained by quite simple means, viz., the use of concealed units in the roof of the portico. There are three units, equipped with 150-watt lamps in special lanterns, mounted in the roof in the rear of the portico itself. There are also six 60-watt lamps placed in the roof behind each of the six columns, with 100-watt lamps above the columns at the east and west ends. These eight smaller units are enclosed in specially designed chromium-plated reflectors.

We understand that this step is the result of a suggestion made by Bailie McKechnie, the late Convenor of the Lighting Committee, which was successfully carried out after a considerable amount of experimental



work. The main object of this specially concealed lighting was the elimination of the sombre effect of the huge black mass which the Academy formerly presented at night. This has been done by quite simple means and without attempting to floodlight the entire face of the building.

The view from the opposite side of the thoroughfare is quite artistic in effect, the contrast between the inner line of columns and the front columns being very striking, accentuating as it does the symmetry and strength of the supporting pillars, and showing up the fine design of the stone frieze which stretches across and above the main entrance.

We understand that the effect has been the subject of much favourable comment in Edinburgh, and it is probable that the south portico will be treated in a similar manner.

Sheffield Illumination Society

The annual meeting of the Sheffield Illumination Society was held in the Corporation Lighting Department on the 8th December, the President, Mr. J. Styring, presiding. The Hon. Secretary, Mr. E. Marrison, reported a very successful session, the membership being 107, and expressed thanks to the Sheffield Libraries Committee for additional valuable works on illuminating engineering obtained at the request of the Society.

The officers for 1931 are as follows: Hon. President and Founder, Mr. J. F. Colquhoun; President, Mr. J. Styring; Vice-President, Mr. A. C. Burrell; Hon. Secretary, Mr. E. Marrison; Assistant Secretary, Mr. M. G. Lockwood; Treasurer, Mr. R. Parker; Auditor, Mr. N. Schofield; Committee, Messrs. A. L. Williams, C. Hallam, R. Allen, G. Wilson, Herbert Twigg, J. Oates, W. G. Brookfield, H. E. Hoyle and E. Selwood.

Shop and Display Lighting

At a demonstration of shop lighting, given to the members of the National Display Association at the E.L.M.A. Lighting Service Bureau, Savoy Street, W.C., on Wednesday, December 3rd, Mr. W. J. Jones, M.Sc., the manager of the Bureau, said that considerable progress in shop and display lighting had been made. The primary objective of the display man is to get rid of close window dressing, whilst that of the illuminating engineer is to get rid of glare. Concentration on these primary objects represent the main channels of future development. The art of open dressing in principle has widened the entire scope of display, permitting a conception of the window as a whole. Colour and balance play an important rôle in modern display.

Lighting has become more and more important as the art of display has progressed. The public are educated to a higher standard of light consciousness, and the cinema and theatre have made a great contribution to this achievement, and they—the public—expect good lighting in the modern shop.

The two main functions of modern shop and display lighting are: (1) to enhance the display; (2) to provide attractive force, especially from a distance. To retain definite and decorative competitive attractiveness is necessary to-day. In the past shopkeepers were parsimonious with electric light; to-day there is little need for this owing to price reductions.

After dealing with island sites, re-entrant windows, signs, facias, and all the special features of the modern shop, and illustrating each point with apt lantern slides and demonstration, the lecturer closed a helpful talk by indicating the value of using luminous features in window display.

The number of talks and demonstrations of shop-window lighting during recent months must have been very considerable. Certainly it would be difficult to find an aspect of lighting which is more readily appreciated by the public, and the "business appeal" in this case invariably meets with response.

Schoolboys' Exhibition at Olympia

The Lighting Service Bureau Exhibition

(*Communicated.*)

A SCHOOLBOYS' exhibition! An exhibition for schoolboys! What a vista of rare and rich possibilities the idea calls up. As Byron happily sang: "Ah! happy years! once more, who would not be a boy?"

To recapture the mind of a boy with his ever-changing tastes, and the mind of the modern boy in particular, is no easy task for mere man.

What captures the imagination of the boy to-day? Is it mechanical adventure by air, land or sea? If this is true, then one thing must be avoided at all costs, if his respect is not to be forfeited; nothing must be dated. The latest type of aircraft, or other mechanical device, will only be accepted for illustration or demonstration by the modern boy.

It is thoughts like these, and a realization that less will not suffice if success is demanded, that adds a trifle to the perplexity investing the adult mind when it is called upon to devise an exhibit the aim of which is to appeal to and interest schoolboys.

Realizing all this, the E.L.M.A. Lighting Service Bureau sought for a theme that would lend itself to description and demonstration along lines likely to appeal to the imagination of youth, to a schoolboy's conception of the *romance of reality*.

Taking as its subject "Electric Light in the Service of Man," the dominating features of its display stand at the *Daily Mail* Schoolboys' Exhibition, opened on January 1st, 1931, at Olympia, are three most fascinating applications: (1) Safety in the air; (2) safety on the road; (3) safety at sea. The central feature of the stand display is in "aviation lighting." This is a new and most fascinating field of lighting, rich in its opportunities and possibilities.

Constructionally, the three main features of the exhibit are triangular in form.

In the centre, dominating to a certain extent but not dwarfing other features, is the safety-in-the-air display. At the summit of the top tripod is an air-route beacon, lighted, and in the space formed by the legs of the tripod will be a 3-ft. model air liner, complete with navigation lamps. A real schoolboy's delight, "the wonder of an hour," as Byron so aptly phrased it.

Surrounding this model is a system of flashing-sign lamps with red hoods that imparts life to the display and suggests the "danger nature shrinks from."

Nor is this all; for, on the three sides of the stand, level with the eye of the average schoolboy, a number of exhibits are displayed in glass cubicles, such as an illuminated wind-cone (operated by a fan), special aviation lamps, boundary-marking lights, landing floodlight, and navigation lights. This central display, 12 full feet in height, was arresting, "a schoolboy's tale," both educative and interesting.

The story of roads is perhaps more familiar, but the story of "safety on the road" is only just being written. The growth of industry was followed by the growth of travel, the pack-horse gave way to canals and coaches, then came Telford and Macadam, horse-power has now succeeded the horse, and speed with its attendant luxury and dangers reigns supreme to-day. Sir Arthur Stanley recently stated that our arterial roads are "needlessly dangerous"; this is equally true of our streets, and the exhibit does show how the electric lamp is helping to solve innumerable traffic problems.

The outstanding features of this section are: a three-way traffic signal operating on an automatic control; a modern lamp-post which can be switched on and off by a photoelectric cell, operated by any visitor to the stand; an illuminated warning sign; and a floodlighted traffic officer. These, with anti-dazzle headlights and a time-switch display, provide a vitally useful and delightfully attractive exhibit, and one with ample facilities for the schoolboy to vent his powers as an operator.

The third of the main displays is devoted to "safety at sea." There is a romance about the sea that captures a boy's imagination, and often causes him to think. The poet who called the sea "relentless" diagnosed its character correctly, and the exhibit indicates the part electric light is playing in diminishing the peril and increasing the safety of travel by sea.

To a "soaring human boy," with his "running stream of sparkling joy," a lighthouse is always an object of considerable interest and wonder.

The 2-in. lighthouse dioptric system, equipped with incandescent "change-over" lamps visible through one of the panels, and "a navigation-light display," designed to show realistically how the failure of any navigation light on a ship is immediately brought to notice by a navigation-light indicator, both excite attention and fill the schoolboy with wonderment.

Apart from this trinity of display features, the stand has as a decorative lighting background a number of other items with lighting effects, e.g., "a model factory" and a "model shop," a "striking silhouette sign," "standard lamp cabinet," and a "progress display." A floodlighted background adds to the value of the complete display.

The joy that comes to boyhood when it is able to toy with some mechanical device, set something in motion, is present at the exhibition, and in particular at the Lighting Service Bureau stand; but beyond this there is a genuine interest in the dominating principle of "safety," and the great service electric light plays in the securing of such.

Mr. Alexander Cramb, M.I.E.E.

APPOINTMENT AS DIRECTOR OF THE BRITISH ELECTRICAL DEVELOPMENT ASSOCIATION.

We learn with interest that Mr. A. Cramb, the Engineer and Manager of the Croydon Corporation Electricity Undertaking, is to be the new Director of the British Electrical Development Association in succession to Lieut.-Col. W. A. Vignoles.

Under Mr. Cramb's supervision considerable progress has been made in Croydon since the war, and the station is regarded as one of the most efficient. Mr. Cramb, however, has been active in many other directions. He has acted for ten years as Hon. Secretary of the Incorporated Municipal Association. He is a past member of the Council of the Institution of Electrical Engineers, was President of the Association of Public Lighting Engineers in 1927, and has worked on numerous committees.

These connections, which have made him so widely known throughout the electrical industry, should stand him in good stead in his task of strengthening the position of the E.D.A. and still further extending the scope of its activities. We wish him every success in his new work.

Design in Modern Lighting

"MODERN Lighting" was the title of a paper presented by Mr. R. D. Best to the Designs and Industries Association, at its meeting at the Institution of Electrical Engineers, on the 24th of November. The author explained, however, that he had decided to confine himself to fittings used for interior lighting in the various forms of pendants, brackets and portable standards.

One of the matters that troubled the author was the description of "fancy fittings," applied to this class of product in commercial circles. The lack of a dignified name for lighting fittings probably hampered not merely the status of the trade, but also the standard of general design. It was highly desirable that some suitable approved name should be found in this country for the surrounding and supporting media essential to modern lighting with light sources of high intensity. The word "Light-carrier," he stated, had been substituted recently in Germany for the older designation of "lighting body," but this was not entirely satisfactory, any more than was the American term of "luminaire." The selection of a suitable term offered a great opportunity for someone to help an important industry.

The large number of lantern slides shown dealt mainly with products of British manufacturers, but was completed by examples of designs from other European countries, such as Germany and France. Many differences in style and in scope were seen. The author pleaded for the motto of the Design and Industries Association, "Fitness for Purpose," to be interpreted in its widest sense; that is to say, according to the more exacting standard of "pleasure in use," which implies the practical test of "living with the actual article."

The difficulty of using unclad light sources, owing to the production of glare, was pointed out. This problem was not a new one. The same difficulty was in fact appreciated in the original oil, paraffin and gas lamps. Curiously enough, the totally enclosed unit for electric lamps appeared to be only a post-war development.

The author suggested that, in general, the distribution of illumination roughly followed the surface of the glass. Therefore, squat drum-shaped diffusers, with a proportionately large horizontal surface, tended to concentrate the light on the ceiling and floor surfaces. Hence this style of globe required closer spacing than did tubular fittings.

The postulation of these effects led to the exhibition of the application of the modern moulded glass, particularly in a globular form, introduced by Lalique, which enabled the production of practical and economic units of highly artistic and durable design to be constructed. The somewhat flat and depressing effect created by totally indirect lighting, which has, however, specific advantages, was demonstrated as being overcome by the use of a translucent bowl. An excellent example of such a fitting was shown, as well as the other method of avoiding the effect by the "Duplexalite" unit, constructed with metal tiers arranged in such a way that some of the light is used to illuminate the outside of the unit itself, thus making it appear as "alive," instead of a "dead" mass. Further embellishment could be introduced by invisible spots of colour on the inside, from which light was reflected on the visible dispersing surfaces.

A form of opal-glass reflector, which can be assembled so as to be used both for pendants and for table or floor standards, was illustrated in both forms, with the criticism that although there was technical merit in the idea, a real objection was present in that it failed to fulfil the practical test of "pleasure in use," while it exemplified a new proverb enunciated on this occasion: "Not all that is functional in form actually functions."

The control over light distribution which Luckiesh has shown can be obtained by housing reflectors in suitable constructions was typically illustrated by a fitting fixed near the porch of the Truro Cathedral, containing silvered glass reflectors for effectively illuminating the carvings, the reflectors being rendered unobtrusive by three auxiliary lamps, radiating their light through glass side panels which shrouded the mechanical elements of the assembly.

Tendencies in architecture and interior design have passed through great changes in the last 50 years, some of the distinctive names being impressionism, futurism, cubism, and other "isms," all of which have had a transient influence. The definite stages which have led from the period of childish ailments known as the "Art Nouveau" or the "Jugendstil" to the phenomena shown at the Paris Exhibition in 1925, and the very marked style which has appeared in Central Europe since the war, are difficult to trace, but the author put forward the suggestion that there are two elements in the present-day European design. One is simply a gesture of impatience with all tradition, and closely related in its essence to the Barock movements of the 17th and 18th centuries, and the other has its roots well down in the present machine age, embodying absolute simplicity and elimination of everything but essentials, with scrupulous adherence to the ideal of "fitness for purpose."

It is strange to see such apparently contradictory influences side by side. Yet they do co-exist, and there is an unreasonable straining after modernity, at a time when the manufacturer and designer should be striving by practical experiment to produce something decent and "fit to live with," using the properties of the raw material they are working with to the fullest extent. It was a thousand times better, the lecturer asserted, to copy some "period piece" of proved worth, such as imitation candles, dust traps and all, than to follow the lines of some of the recent designs of the misdirected geniuses, of which typical examples were exhibited.

Striking and characteristic designs of modern lighting fittings illustrating the various points the author desired to comment on or emphasize (and these included both examples of satisfactory quantity-production methods and a very large range of ideas and applications) were displayed, although, naturally, the photographs from which the lantern slides were prepared failed almost entirely to embody the beauties of colour and tone that were intrinsic properties of the shaded glass panels. Passing on to fittings designed specifically and appropriately to match and harmonize with the surroundings, the following, amongst others, received notice: the crystal fittings constructed from the designs of Mr. Norman Wilkinson, forming "sunbursts" with mirrors above, for Messrs. Atkinson's shop in Old Bond Street, London; the box type combined with horizontal laminæ designed by Messrs. P. Morley Horder and Verner O. Rees and constructed by the author's firm for the library of the School of Hygiene; and fittings designed by Mr. Oliver P. Bernard for the grill room of the Trocadero. The new so-called "strip lights" covered by opal tubes, as used by Troughton & Young, were shown as characteristic British examples, followed by pictures of the Gourmenia Restaurant in Berlin (mentioned in our August, 1930, issue).

Reference was also made to the unusual and probably unique illumination of the barber's shop in the basement of Austin Reed's Regent Street premises. This installation consists of a series of opal-glass tubes about three inches in diameter, bent into semi-circles and containing the lamps, aggregated into a long series of waves traversing an oblong path close to the ceiling, a very striking example of modern lighting methods resulting from a Harcourt creation, adopted by the architects, Messrs. Westwood & Turnbull.

The excellent artistic work emanating from such architects as Messrs. F. T. Verity, T. Beverley, Paul Trent, Walmsley Lewis, etc., and carried out by a series of well-known British fitting makers, also formed part of the paper, and was shown by lantern slides.

The author paid high tribute to the European designers, saying that the Germans had, by sheer hard work, with practical trial and error, achieved a level of performance outstanding in Europe today; it was a significant thing that this was a group performance and not an isolated and sporadic burst of creative endeavour unrelated

to anything else, and was therefore a sound organic movement. The same thing in a lesser degree could be said of contemporary French and Spanish designs. In each case, although the influences came from outside, the growth was healthy and natural because it had its root in things which were national and the cumulative effect of team work could be obtained. He asked whether we could say the same thing of contemporary English work. As regards his own industry, he felt that, although excellent work was being done, we were all unjustifiably suffering from something like a sentiment of inferiority which is preventing us from advancing in a freer style from the start already given to us by other nations. There is so much excellent material available which ought to be used, and too much copying of foreign ideas should cease; otherwise our export trade would be hampered by the impression that British ideas were inspired by foreign developments.

The author concluded by a quotation from Mr. Sturge-Moore, a poet, who was an extremely practical and sound writer on design and taste, namely: "The process of creation begins with accumulation; so a bird builds a nest, or feeds its young. This preparation may in the artist often be unconscious. At length a series of efforts are made to use or prove this store; some fail and are repeated, some succeed; so the swallow pushes her nestling over into the air; so the young thrush hops and flaps its wings; so boys were tumbled into water to teach them to swim, so they throw stones till they can aim straight, so too the young artist flounders in paints, the young poet scribbles rhymes." This, he felt, contained the whole substance of design, whether in the electric-light fittings or any other trade.

Architectural Illumination

It is but necessary to remember that sight is the chief factor in man's intellectual development, and that this has been evolved under conditions of natural daylight, in order to realize why the eye is not readily prepared to adapt itself to modern conditions of artificial lighting, and why the subject of "architectural illumination" is a comparatively new one that is as yet not fully explored.

A valuable contribution to this subject was recently made by Mr. Raymond McGrath at a meeting of the Design and Industrial Association, at which both architects and experts on the design and application of illumination apparatus and installations were present.

Everybody is familiar with the great part that artificial illumination has come to play in our daily lives during the last half-century, and how it now enters into all forms of modern art. In the films impressive and superb dramatic conceptions are built up almost entirely of light and shadow, and these vie, but modestly, with the actual appearance of modern cities and buildings.

In the endeavour to fully exploit their efficiency to the utmost, the earlier forms of modern illuminants were used unscreened. The prejudicial effect on the eye of the high intensity seems to have been first appreciated by oculists when they, in 1898, petitioned Parliament to pass laws against unshaded electric lights. This incident in the progress of illumination is of considerable interest, as oculists now claim that nine out of every ten persons over 21 years of age has imperfect sight, and that it is almost impossible to find a man over 40 with perfect vision.

That unique city, in many ways, Chicago, claims the honour of first adopting, in 1908, the enclosure of incandescent lamps, but there is no doubt that from about this date the benefit of indirect light came to be widely appreciated. The adoption of a bare light source is now universally deemed unsuitable for any purpose.

This rational advance in illumination methods, however, has far from solved the problem of providing correct illumination of a character free from any liability to induce mental and physical fatigue, which imparts invigoration to the user and restful beauty to the surroundings.

Two aspects of illumination have to be borne in mind —quantity and quality. If the intensity is carried beyond a certain point the image appears blurred, and the observer feels dazzled and confused.

Efforts have been made to determine the efficiency, in the sense of elimination of fatigue, of diffused daylight, and with indirect, semi-indirect and direct artificial lighting. Comparative figures on such points can only be regarded as approximate, owing to the variety of factors that need to be taken into consideration—such as the enlivening effect of high illuminations and the sedative influence of weak ones. Other conditions, such as distribution of brightness and contrast, also exert an influence. Both monotonous and excessive illumination blunt our powers of appreciation.

In good lighting it is generally necessary to eliminate harsh shadows, but this may only produce "shapelessness" and directional lighting must therefore often be added to secure the production of shadows of just the right quality. The most artistic interior effects demand variety and mobility of light in order to avoid the commonplace. We are refreshed by the variations in intensity and qualitative difference in colour, for the fascination of natural light consists in its rhythmical and constant change.

The appreciation of quality of light is a highly developed sense appertaining to visual perception, and, therefore, colour is now playing a greater part in illumination. Certain colours constitute "shadows" in themselves; thus, the eye is most sensitive to yellow, while red is the most fatiguing; green and blue-grey, the most prevalent ones in nature, fatigue the eye least, while the greatest speed and power of clear vision is obtained by using the light colours near the middle of the visible spectrum, i.e., blue-green and yellow.

The application of such facts to interior architecture is of the greatest importance, and consequently orange, yellow, green, and blue will be the colours selected where the illumination is dependent on reflection from surfaces. In general, particularly in domestic work, light tinted monotone walls and ceilings free from emphatically coloured designs afford the best reflecting and diffusing surfaces, while if the ceiling is the same colour, but a few shades paler, harmonious and spacious effects are more readily obtained.

The practice of building a room and then filling it with lighting fittings is a relic of the days when illumination was a matter of the impermanent candle or torch, and is out of consonance with the known possibilities of present-day illuminants.

Modern methods of lighting may be divided into three varieties—direct, indirect-diffused, and directional, and it is the correct application of one or more of these to the requirements of the locality that must be considered. Some factories preclude the slightest amount of directional lighting, the distinguishing of shape being by colour; in other cases, as for instance in a foundry, shadows are essential for the same purpose. Offices may have natural outdoor illumination introduced by indirect lighting, while on the theatrical stage a shadowless illumination must be modified by floodlighting. Electric signs are but now receiving the full study they need, and none of the existing imposing examples, such as seen in Piccadilly Circus and Blackpool, can be considered as revealing finality. The illumination of interior as well as exterior sports-places also opens a large field for beautiful results, pre-eminent among which is the floodlighting of bathing pools, both by under-surface illumination and by overhead floodlights, to add, in the absence of the moon, a sparkle to the surface.

In presenting his valuable contribution from which the above abstract has been made the author made use of a number of lantern slides of suitable examples, demonstrating the points of his arguments, which had appeared in architectural and art publications, and also in books that he had himself written.

The Oxford Ice Skating Rink

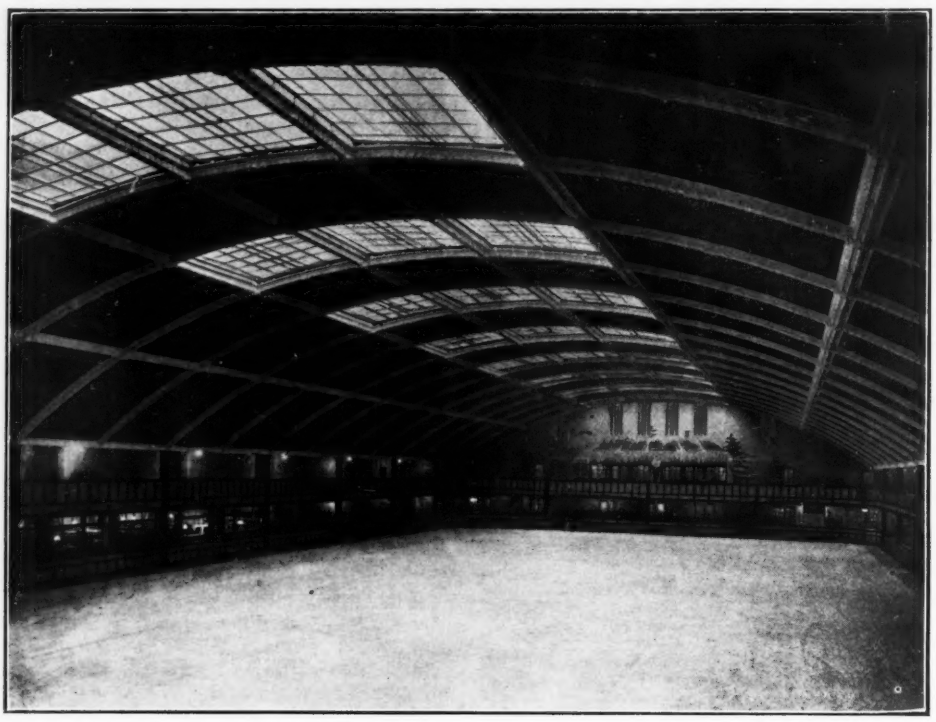


FIG. 1.—A view of the Main Hall of the Oxford Ice Skating Rink.

FRIDAY, the 7th November, saw the opening of the new ice skating rink at Oxford, which is one of the largest covered ice rinks in Great Britain.

The rink has a skating area of 20,000 square feet, being 200 ft. long and 100 ft. wide. It is housed in a magnificent building on the Botley Road, Oxford, and every convenience has been provided, including a luxuriously appointed restaurant, club room, lounge, and all the necessary accommodation for a well-organized rink of high standing. A brief description of some of the most novel features of the artificial lighting of this ice rink may be of interest.

The main hall (Fig. 1) is constructed with a single span, there being a barrelled false ceiling some 16 ft. from the roof proper. The false ceiling is divided by beams into seven sections longitudinally and 18 sections laterally. The three centre longitudinal sections are utilized for both the natural and artificial lighting of the hall.

In every alternate bay the centre ceiling panels are glazed with rippled glass, which gives sufficient diffusion to eliminate any suggestion of " spottiness " from the lighting units which are installed above. Above each of the 27 glass panels are fixed two Holophane heavy-duty concentrating prismatic reflectors, fitted with 750-watt and 500-watt lamps, at heights ranging from 7 ft. to 15 ft. above the glass, depending upon their situation. As a result of the arrangement and selection of the reflectors and the careful planning, the system has given a remarkably even intensity of illumination over the whole ice area. The glass-roof panel too shows no sign of patchiness so common with most forms of ceiling panel lighting, as is evident from the picture. A further elaboration is designed in this ceiling for moonlight effects, a second battery of Holophane prismatic reflectors being installed, equipped with " daylight " lamps.

The hall is surrounded with balconies arranged with seating accommodation for spectators. Over and under the balconies are fitted Holophane prismatic globes with daylight lamps, which gives a contrast and atmosphere to the purpose of the rink, which is enhanced by the blue-and-white paintings of Alpine scenery.

The restaurant, which is on the ground floor and open to the rink, has a warmer atmosphere. The main lighting takes the form of large close ceiling fittings, 3 ft. long by 2 ft. wide, formed with the latest Holophane Hedralite prismatic glass panels. Each fitting is

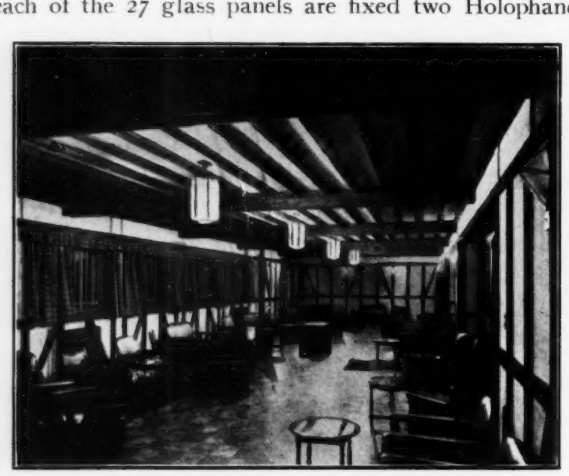


FIG. 2.—The Club Lounge.

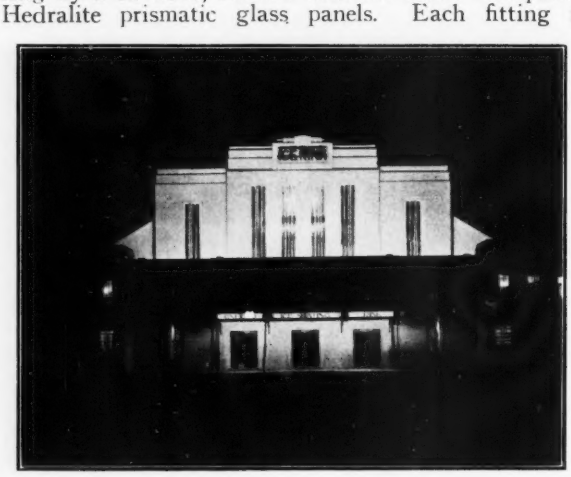


FIG. 3.—The Illuminated Frontage of the Club.

arranged with six 75-watt lamps. On the tables are tastefully arranged stand lamps of subdued colours, the whole effect being extremely pleasing.

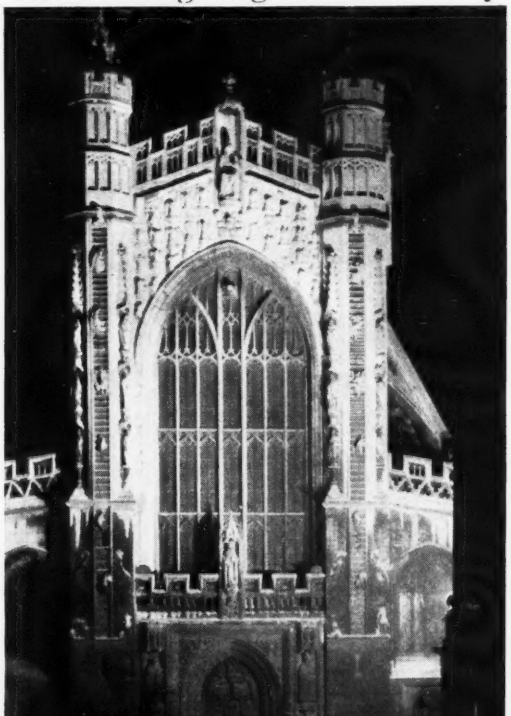
The club lounge (Fig. 2) is a very spacious and comfortable room, designed on the Old English oak-panelled style so suitable to the University city of Oxford. The artificial lighting here has been carefully chosen to be in keeping with the general design and purpose, and employs as central pendant units the long four-panel Holophane Pagoda fittings. Bracket points are arranged around the walls, and these are a special pyramid form constructed with Holophane Hedralite triangular prismatic panels.

The entrance hall is of similar construction, with a rather low ceiling. Here the lighting is carried out using close ceiling Holophane Hedralite fittings similar to those installed in the restaurant, with also a Holophane Pagoda fitting hanging in front of the ticket office.

The imposing features of the modern frontage of this rink are illuminated at night by Holophane prismatic floodlight projectors, whilst, under the veranda, three Holophane Hedralite octagonal globes of light are installed. (See Fig. 3.)

The artificial-lighting installation was designed by the consulting electrical engineer, Mr. Percy W. Berry, who is also the manager of the ice rink, in conjunction with the Technical Department of Holophane Ltd., Westminster. The electrical contractors were Messrs. F. G. Alden, of Oxford.

The Floodlighting of Bath Abbey



The floodlighting of the front of Bath Abbey has been mentioned as one of the most distinctive pieces of floodlighting recently undertaken in this country. The accompanying illustration gives a good idea of the effect of this installation, which was carried out by the Bath Corporation Electricity Department. The lighting is effected by a number of G.E.C. floodlights, equipped with 1,000-watt Osram lamps. It may be recalled that the tower of the Abbey was illuminated some time ago in connection with an important conference held in that city. Floodlighting as applied to churches and cathedrals is becoming increasingly common. Church towers, by reason of their isolated position, in general lend themselves well to floodlighting; if restraint is exercised, the lighting should greatly enhance the appearance of the building by night.

TRADE NOTES & ANNOUNCEMENTS

EFFECTIVE TRAMCAR LIGHTING.

The accompanying illustration (Fig. 1) shows the lighting of one of the Birmingham Corporation tramcars by means of Siemens majolica fittings, traction lampholders and "Silvalux" opal gasfilled traction lamps. As the photograph (which was taken entirely by the ordinary lighting inside the tramcar) suggests, the light is well diffused, with soft shadows and agreeable absence of glare.

There can be no doubt that opal lamps of this kind are proving a godsend for the lighting of trains, buses and tramcars, where considerations of weight and limited overhead space render it difficult to employ elaborate diffusing glassware.

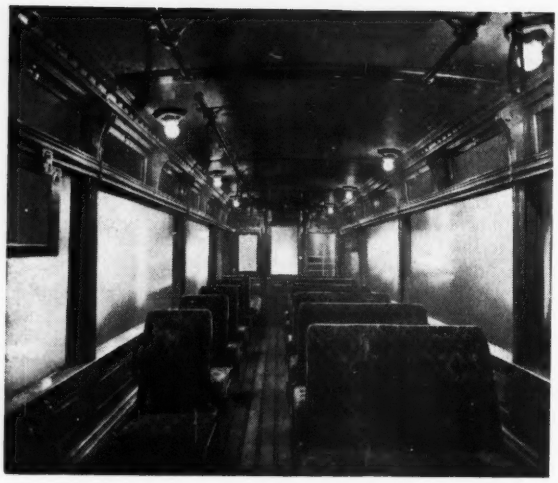


FIG. 1.—Effective Interior Lighting of the Tramcars of Birmingham Corporation.

SCIENTIFIC INDUSTRIAL ILLUMINATION.

This is the title of a new 64-page booklet recently issued by Holophane Ltd. The introductory explanatory matter, dealing with general principles of lighting, foot-candle intensities and definitions is on familiar lines but has been extended, and the variety of lighting fittings illustrated is considerable. New forms of industrial reflectors for localized and general lighting in factories are shown, one feature being a reduced angle of cut-off. Other recently introduced units include industrial units with cover glasses, industrial reflectors for local lighting, and vapour and water-proof globes. At the end of the booklet there is an attractive series of views of industrial lighting installations and there is also a section illustrating the varied applications of Holophane floodlighting units.

A GOOD EXAMPLE OF CHURCH LIGHTING.

We are indebted to Messrs. Siemens Electric Lamps and Supplies Ltd. for picture (Fig. 2) showing the lighting of All Saints' Church, Friern Barnet. This installation was carried out by the North Metropolitan Electric Power Supply Co. The main lighting is effected by means of Siemens-Holophane floodlight units mounted in the roof, so that the fittings are well out of the range of vision. Trough reflectors, fitted with Siemens opal lamps, are also installed behind the Chancel Arch, so as to afford light for the choir and strengthen the lighting at the east end of the church. A feature, as seen from the street, is the pleasing appearance at night of the fine stained-glass windows of this church.

FIG. 2.—The Lighting of All Saints' Church, Friern Barnet.

NEW GLASSWARE DESIGNS.

From Messrs. Hailwood & Ackroyd Ltd. we receive several leaflets showing attractive lines of glassware recently introduced. Amongst these are etched (*verre gravé*) shades of pleasing types. We note also a novel form of table-lamp fitting which can be built up into various forms. The prices quoted for these lines of British-made glassware certainly appear very reasonable, and we are not surprised to learn that they compare very favourably with those of glassware made abroad.

A NOVEL TRADE FILM.

A highly enterprising step was the recent display before members of the Cinematograph Exhibitors' Association, and others, of the first "all-talking orchestrated trade film" shown in this country. This film dealt with the manufacture of arc-lamp carbons, cinematograph projection carbons, battery carbons and brush carbons. The film bore the title "Strike up Friend Ship." Mr. Charles H. Champion, Managing Director of the Ship Carbon Company of Great Britain, opened the proceedings by calling upon the Rt. Hon. C. A. McCurdy, P.C., K.C., who, in introducing the film, emphasized the importance of being able to rely upon a home supply of carbons.

FIG. 3.—The "Mazda" Decorated Lorry at the Hinckley Carnival, promoted by the Leicestershire & Warwickshire E.D.A. Circle.

REVIEWS OF BOOKS AND PUBLICATIONS RECEIVED

"DAS LICHT."

"DAS LICHT" (*The Light*) is the title of a new journal devoted to illumination, issued under the auspices of Dr. Adolph, a Director of the "Bewag" (the joint authority which supplies electrical energy to the population of over four millions constituting Berlin), and published by the firm of Alexander Ehrlich, of that city. The value of a technical publication is largely dependent on its editorial direction, which in this monthly issue is, so far as concerns the section intended for the lay reader, in the hands of Messrs. L. Schneider and W. Peters, names well known in connection with lighting matters; while a happy choice has been made in the selection of Prof. Dr. J. Teichmüller as editor of the section devoted to science and research.

The list of collaborators seems to include leading German experts on most branches of the lighting industry. (We notice with interest the inclusion of one lady contributor, Frau H. Margis, Member of the Executive of the Housewives' Association of Great-Berlin and of the National Union of Housewives.)

The inauguration in Germany of a second journal devoted to light and illumination at a time of great financial and industrial depression would seem a somewhat courageous venture, but those responsible are evidently influenced by the growing demand for information on the subject.

The avowed intention of placing before readers technical, economic and cultural aspects of light in a simple and attractive form is well illustrated in the first number. The initial article, by Dr. E. Redslob, deals with the universal importance of light, and makes the claim that light is the gauge by which all things are tested in the present epoch. This is followed by a note by Dr. Petersen, emphasizing the "pioneer value" of electric light in the electrical supply business.

The industrial value of good lighting in relation to output and elimination of accidents is pointed out by Ch. P. Jensen, whilst the cost of bad lighting forms the subject of a long article by W. Kircher and L. Schneider. Reference is made in this contribution to the investigations of the Medical Research Council and the Department of Scientific and Industrial Research in this country.

Starting from the elementary fact that in the absence of light no effective advertising is possible, Dr. A. Knapp, who was secretary of the World Advertisement Congress of 1929, deals with the physiological and psychical elements of advertising. The view of the lady of the house is expressed by Mrs. Margis, who discusses various applications of electric light in the home, and concludes with the remark that niggardliness in lighting is never real economy.

A series of articles on "The Problems of Street Lighting" is commenced by E. Höltscher and a technical description given by Dr. Gerhardt Schmidt of the lighting effects at the 1930 Stockholm Exhibition. Other general information, including notes on development in foreign countries, is embodied in a special section.

The section under the supervision of Prof. Teichmüller commences with an article by him reviewing the present position in illuminating engineering. This is intended as an introduction to subsequent notes, and accordingly a bibliography of recent publications, confined, however, to German ones, is included. A dissertation by R. C. Weigel, the chief assistant at the Karlsruhe Institute, on "Photometric Sensitivity," contains, amongst others, the following conclusions: (1) Pure isochromatic spectral colours can be measured within a limit of error of from ½ to 1 per cent.; (2) the sensitivity for this class of measurement is practically independent of the colour. As many reports will be issued in further numbers of *Das Licht* emanating from the *Lichttechnische Institut* at Karlsruhe, a description of this unique research and training establishment is given.

Throughout the number there are many good illustrations, while the adoption of roman and italic type faces facilitates easy reading.

INDEX (January, 1931).